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INVESTMENT FOR PUBLIC WELFARE[1]

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

EVERY person makes some sort of financial investment for the benefit of the public. Through taxation he contributes, willy-nilly, to those public services operated by the government. If his income exceeds his necessary expenditures, he frequently makes voluntary gifts. In either case, it is a matter of natural concern to him that his investment be efficiently administered for purposes of unquestioned social value. If his investment is by voluntary gift, as to a charitable institution, he naturally selects the objects of his altruism with care; if it is through the taxation route, he is too often insufficiently alert to the type of judgment and management exercised by his elected agents, the government.

[1] Address at the annual dinner of the Technology Club of New York at the Waldorf-Astoria, New York, on the evening of May 6.

As contrasts of stewardship and wisdom in handling our money for the public welfare I choose two examples of approximately equal size, the Passamaquoddy Power Project and the Massachusetts Institute of Technology. The former illustrates a type of government expenditure uneconomically and politically conceived; the latter typifies the better class of educational institution or altruistic foundation. If you prefer illustrations on a still larger financial scale, take the Florida Ship Canal and Harvard University, or the completed Grand Coulee Dam and the Rockefeller Foundation.

The Passamaquoddy Power Project, if carried through, will realize man's long-cherished dream of harnessing the tides in a large way. Perhaps its appeal to the imagination accounts for the fact that the government has appropriated $7,000,000 and has

spent $6,000,000 for it before ascertaining if the plans were technically sound. In its present "third revised edition" it has been officially estimated to cost $36,250,000. More careful geological study reveals, however, that the plan of a high altitude reservoir, pumped full during the tide power interval and supplying power during the remainder of the daily cycle, involves difficulties. To surmount these or to provide an alternative source of reserve power will cost several times the $9,000,000 set aside for this item in the original estimates, according to expert opinion. There are other features which similarly point to increased cost, so that the actual bill for the completed project will probably not be less than $48,000,000.

What returns, of social value, to justify this expenditure, are expected? The Quoddy project is planned to deliver some 30,000 kilowatts of electric power. Its investment cost will be more than $1,500 per kilowatt, a figure so high that it could not compete in economy with a steam plant, even if its operating and depreciation charges were completely ignored. A steam plant to produce the same power on the same site would cost approximately $100 per kilowatt. It has properly been said that this project "breaks all records in getting the least electricity for the money."

There is no present demand for this power, and nothing but vague suggestions and hopes for its possible future use. The attempts to prove a by-product value are equally vague and unconvincing. Its actual operation could only be at the expense of every taxpayer and the simultaneous destruction of public utility companies which now serve the region adequately and more cheaply.

Your money and mine, in the form of taxes levied ostensibly to promote the public welfare, pays for the Quoddy and other similar projects. Would you, by choice, spend your money to promote public welfare in this manner? Let us present to you a contrast in values.

The Massachusetts Institute of Technology represents an investment of $48,500,000, of which one third is in plant and two thirds are in endowment. It has produced, not 30,000 kilowatts, but 30,000 alumni. It has played a powerful rôle in the scientific and technical developments that have brought to the people of this country a large portion of their employment, safety, health, comfort and convenience in living. More than a thousand of its alumni are teachers, widely extending its educational influence. Nearly 10 per cent. of its students come from 39 foreign countries, forming a strong international link of friendship and commerce.

M. I. T. graduates are heads of research laboratories, executives in industrial, building, transport and power enterprises of foremost rank; heads of important banking and investment institutions; public servants for cities, states and the nation. They permeate the new technological America. Let me quote a few examples.

Technology graduates are presidents of General Electric, General Motors, du Pont, Goodyear, Eastman Kodak, Stone and Webster, United Fruit, Sun Oil, Winchester Arms, Babson's, Central Railroad of New Jersey, Technicolor, American Brake Shoe and Foundry, Douglas Aircraft, Bell Laboratories, Thomas A. Edison, Inc., Phelps Dodge, Campbell Soup, Revere Sugar, Jos. T. Ryerson and Son, Vermont Marble, Niagara Power and a host of other companies. The number of chairmen of boards and vice-presidents is legion. Among the graduates of electrical engineering, just one of the eighteen departments, are 105 corporation presidents, 67 vice-presidents and 27 chief engineers. Of the 23 Associated Factory Mutual Fire Insurance Companies, which have done such splendid work in developing methods of fire prevention, nineteen have Technology men as presidents!

In the field of finance we find M. I. T. men at the heads of such institutions as the First National Banks of Boston, Denver and Portland, Oregon; The Equitable Trust and Guaranty Trust Companies; Hayden, Stone and Company; First Boston Corporation; American International Corporation; Bank of America.

Every vessel now in the United States Navy was designed by former M. I. T. students and built mainly under their supervision. Technology built and operated the first wind tunnel and established the first course in aeronautical engineering in America. Today a "who's who" list in American aviation, whether civilian or military, technical, industrial or even in pioneer flying, is strikingly a Technology register. The same statement can be made with respect to the nation's physical chemists. Among the many prominent architectural graduates are the heads of a dozen schools of architecture.

The modern profession of chemical engineer was created at M. I. T., and its graduates in this field are absorbed by industry like molecules by a vacuum. It was the first technological institution to recognize and provide for the important place of economics in the training of the engineer. In collaboration with Harvard, it established the first systematic training in public health, and its staff performed a major portion of the pioneering work in developing sanitary municipal water and milk supplies, methods of sewage disposal, municipal public health surveys and methods for protection of canned foods on an industrial scale from bacterial action.

Specific examples are more convincing than generalities. I therefore take the cases of two civil engineers who have been continually closely associated

with the institute. Of one, a recently deceased member of M. I. T.'s corporation, it has been written: "The scope of civil engineering has been admirably demonstrated in this country by a distinguished graduate of M. I. T. who was consulted on the Panama Canal and on the Keokuk Dam across the Mississippi; organized a nation-wide fire prevention service for fire insurance companies; was president of six insurance companies; was consultant on water supply construction and investigation in Los Angeles, San Francisco and Baltimore; was engineer for the Chinese Government on the Yellow River Control Project; became an authority on the design of buildings to resist earthquakes, and on engineering geology; and promoted the construction of our National Hydraulic Laboratory."

The other, in addition to engineering research, publications and activities in professional societies, has performed the following services to governmental agencies as consultant: Advice to City of Boston on reorganization of public works activities and engineering services, in interest of efficiency; revision of Harvard Square Station, Boston Elevated Railway, and traffic conditions surrounding it; investigation of defects in Worcester turnpike and other problems for the Massachusetts Department of Public Works; consultant for twelve cities in Massachusetts in highway problems; design for rebuilding the district of Salem, Massachusetts, which was burned in 1919; service to several metropolitan cities and towns on apportionment of cost of the Charles River Basin; investigation of sixty schoolhouses for fire protection; revision of Lynn, Massachusetts, sewerage system; design of Little River improvement for Haverhill, Massachusetts; service on Traffic Commission for Cambridge, Massachusetts; investigated Pickwick Club disaster for City of Boston; consulted on elimination of grade crossings for eighteen cities and for the Vermont Public Utilities Commission, involving $40,000,000 of construction work; advised Metropolitan District Commission on freight terminals; advising Massachusetts Department of Public Works on revision of its engineering organization.

These two men are not unique, they simply illustrate the fine type of service which the public receives as the result of institutions like M. I. T. Some, like these, bring safety and convenience through public works. Others create new industries. Others discover new materials, forces and relationships in nature through science. Still others are performing skilled tasks in a multitude of the activities of our modern era. Altogether, they epitomize the American civilization.

Thus far I have discussed the human product of M. I. T., its staff and alumni. But there is also another type of product, comprising the actual results of research and invention that have come from its laboratories. Here the number and variety is so great that I shall make no attempt to enumerate past achievements, but mention only a few of the more significant of the four hundred odd subjects that are now in process of investigation or development.

A new optical material for lenses has just been developed to the stage of commercial production. It is the most transparent and the freest from chromatic aberration of any known solid substance, and its method of production has further applications.

A new method of producing artificial textile fibers of hitherto unequalled fineness is developed to the stage of examining its various possible applications.

Apparatus for detecting the most deadly of known types of poisoning has been perfected and a method of curing this hitherto incurable affliction has been proven successful, and both will be made available to the medical profession within a few months.

Three types of automatic devices for solving hitherto practically insoluble mathematical equations have reached the stage of demonstrated successful use, though they are still being improved. These open up entire new categories of practical applications of mathematics to statistics, engineering design and scientific problems. They have applications also to the automatic accurate control of machinery.

A new form of high voltage generator for x-ray outfits used in medical therapy, operating on radically new principles and with marked advantages and economy over previous types, has been invented and tested, and the first unit is being installed in the Huntington Memorial Hospital.

An entire new and unexplored field of electrical science and electrical engineering has been opened up by a group of recently developed electrostatic machines that show promise of important industrial uses, and are being actively investigated.

A metallurgical study, completed within the past year, is estimated to save several million dollars in the operations of an important industry through elimination of faulty products.

An improved method of refrigeration, embodying several new features, has provided a far more efficient, economical and convenient apparatus than was formerly known for securing very low temperatures. This was built and demonstrated during the current year, and it opens the way to a new important program of research in physical chemistry.

Probably some millions of dollars throughout the world have been spent in efforts to produce more powerful magnetic fields, because of their importance in engineering and scientific research. A new form of magnet has been designed and tested during the past two years which makes possible constant magnetic fields several times as powerful as any hitherto achieved.

For the army engineers a hydraulic study of the Cape Cod Canal has just been completed. With reproduced tides in Massachusetts and Buzzards Bays driving water through an accurate scale model of the proposed widened and deepened canal, tests were made which determined the most advantageous contours, positions for fills, current velocity and effect on the shallow approaches.

A process has been discovered within recent months which shows promise of considerably reducing the cost of manufacture of one of the industrially important acids.

Two years ago the first successful method of dissipating fog over restricted areas was demonstrated, and its practical use in aviation is being explored with the cooperation of interested governmental agencies.

During the past year, for the first time, a method has been devised and applied for impressing on a shaking table an accurate reproduction of the motions of any actual earthquake. It is being employed to develop a new technique of earthquake-safe building construction.

Five years ago a uniquely equipped spectroscopy laboratory was built. Last year a machine was invented which rapidly and automatically performs the computations of spectrum wave-lengths with hitherto unequalled speed and accuracy. This year a staff of sixty-five WPA clerical workers are assisting in the preparation and publication of a revised classified list of wave-lengths of all the millions of spectrum lines of all the chemical elements, a job which, a few years ago, would have been entirely beyond the reach of any institution. This done, a second automatic instrument invented two years ago will facilitate the rapid accumulation of knowledge of atomic structure from this assembled mass of data.

Several years of study of direct and indirect effects of ultra-violet light in curing rickets have led, among other things, to precise determination of the relative effectiveness of light in different parts of the spectrum.

Automatic devices have been developed to record automatically the relative amounts of listening to different radio broadcasts and also for performing automatically the complicated operations of sales recording and accounting in large stores.

Within the year discovery has been announced of the cause of existence of a large class of minerals which previous theories said ought not to exist. This discovery has valuable geological implications and suggests useful applications in the development of new alloys.

Independently of and simultaneously with the Bell Laboratories, there has just been announced a radically new type of conductor for transmitting electrical communications which has interesting possibilities of application that may be extremely important.

A new type of engine, a new method of hardening steel and protecting it from corrosion, new instruments for detecting faults in structural metal, a new device for reducing vibration in aircraft, a chemical form of sex hormone and determination of geological age of rocks—all these are but a few products and activities of the M. I. T. laboratories at the present time!

Here you have the contrast, on the one side a project of complete economic futility and on the other an institution which, in my judgment, has been of greater aggregate value to the country than any other institution based on a comparable investment. If it be argued that Quoddy is justified as a means of giving employment, I would reply first that the direct and indirect employment produced by M. I. T. far exceeds that provided by Quoddy and is permanent, and second that emergency employment could have been found in far more useful projects than many of those selected.

Now a word about the reason for these remarks is in order. At an alumni gathering, a certain amount of self-glorification of the college is traditional and excusable. Also it is customary to say something about current activities in the institution. Both of these elements appear in what I have said, but my main purpose goes further:

I believe that we have only scratched the surface in our program of promoting the public welfare along the lines of our charter, which directs us to "aid generally by suitable means the advancement, development and practical application of science in connection with arts, agriculture, manufactures and commerce." The world, and particularly our own country, are rapidly entering an era in which scientific management and technical skill will be increasingly important. As our geographical frontiers have been expanded to the limit and our natural resources of soil, timber and minerals have been occupied, further increase in wealth or population or satisfaction in living can only come through wiser uses of our existing resources. That is the great challenge of society to science, and that is exactly the field of M. I. T.'s special mission and opportunity.

My belief in the possibility of an enhanced value of the institute to the public is based on careful study of its potentialities of staff, equipment and organization. The educational program requires a staff which includes experts in almost every aspect of science and engineering. Thus there is available for attack on any problem a closely knit, cooperating group with wider range of technical experience and approach than can be found probably in any other organization in the world. Because of the teaching program, there-

fore, this framework of a research organization is already provided. Reciprocally, a staff which is active and alert in handling the live problems of the technical professions is best able to steer its students, as apprentices, into these professions. There is urged, therefore, a more adequate development of our research program along lines that will increase the value of the direct contributions of our staff and advanced students, and whose stimulating influence will permeate down into the undergraduate years.

Despite the splendid record of past accomplishment and the impressive current program of creative activities, it is a fact that we are not making full use of our opportunities. We are able to develop only a few of the promising ideas which are continually occurring to our staff, and we handle those which we do develop inefficiently through lack of facilities. We are in the situation of possessing a great reservoir of scientific discovery, invention and technical skill, without the relatively minor but essential subsidiary help required to exploit this reservoir. We are an organization, which, because of its educational program, has all the overhead necessary for a great research program but which lacks the funds for operating expenses on a scale efficiently to utilize this overhead.

No educational institution in my knowledge has ever approached its possibilities for contributing to public welfare by giving attention to the efficiency of its research program comparable to that which it gives to its teaching. No institution has such great possibilities in this direction as the Massachusetts Institute of Technology. I can imagine no investment for public welfare so likely to secure large returns as one which would permit the latent creative powers of this institution to become really active.

We have done everything that we know how to do to make our teaching program effective and our administrative organization efficient, but by and large we have let the research activities play a subsidiary rôle, supported by whatever funds were left over. Under the circumstances which have existed, this has been necessary and proper. But the fact remains that we have a great opportunity which has not yet been adequately realized. If we could find a few hundred thousand dollars a year to exploit this opportunity, I am as certain as that I stand here that a new epoch in public service by an educational institution would follow.

Amid the difficulties to educational institutions which arise from various current political trends, it is important that the best privately controlled institutions shall maintain the educational leadership and traditions for the benefit of *all* education, governmentally controlled and private. The criterion for survival of a private institution in these difficult days will be that it offer a quality of education and public service definitely superior to that obtainable in governmentally operated institutions. This is the challenge of the future to those who administer the affairs of private institutions and to those who wish such institutions to endure as vanguards and bulwarks of a free and progressive social order.

PLAIN STATEMENTS ABOUT RACE

By Professor EARNEST A. HOOTON
HARVARD UNIVERSITY

INTRODUCTION

MAN is a predatory mammal which has achieved dominance over all vertebrates by a ruthless use of superior intelligence. From prehistoric times this ingeniously selfish biped has realized that the greatest gain of power and booty lies in preying upon his own species. It is easier to seize wealth than to create it. Yet a certain quality of benevolence has been at variance with simple brute predaciousness throughout the long struggle for survival and domination which is the history of this super-ape. Thus, man has evolved certain ideals of humanitarian behavior which often manifest themselves in disinterested and self-sacrificing acts on the part of individuals and even of social groups. This apparently innate generosity may or may not be some sort of social extension of a maternal instinct. Through centuries of painstaking cultivation and encouragement it has been built up to a point where it has sometimes seemed to bid fair to dominate human behavior and thus to inaugurate the millennium. Unfortunately, human altruism seems to distintegrate in political and economic stress, except as an individual phenomenon. It is not a common characteristic of the large political and social groups which we call nations.

Man incessantly seeks to compromise with his conscience or with his innate humanitarianism by rationalizing his predatory behavior. He must convince himself that the act of grabbing is somehow noble and beautiful, that he can rape in righteousness and murder in magnanimity. He insists upon playing the game, not only with an ace up his sleeve, but with the smug conviction that God has put it there.

We need not speculate upon the arguments with which primitive man presumably convinced himself that he was glorifying God by getting dominion over "the fish of the sea, and the fowl of the air, and over

every living thing that moveth upon earth." Possibly the necessity of self-justification arose only when civilization had advanced to the status of cannibalism and slavery, and man had begun to make a real business of battening upon his own kind.

Certainly the specious excuse of racial difference has served ever since Ham saw the nakedness of his drunken father, and Noah, awakening from wine with a bad hang-over, exclaimed "Cursed be Canaan, a servant of servants shall he be to his brethren!" From immemorial antiquity hereditary variations of bodily form have been made the basis of charges of racial inferiority in mentality and in capacity for civilization. With this contemptible subterfuge our European ancestors justified their enslavement of the Negro and their virtual extermination of the Indian and of many other primitive peoples. The "White man's burden" has been mainly one of hypocrisy. With no more savage worlds left to conquer (save only Ethiopia), the White man has turned this same vicious argument to use against his own kind, committing more crimes in the name of race than have ever been perpetrated in the name of liberty.

Under these circumstances, a physical anthropologist, who has devoted most of his research activity to the study of race for nearly a quarter of a century, desires emphatically to dissociate the finding of his science from the acts of human injustice which masquerade as "racial measures" or "racial movements" or even "racial hygiene."

I do not claim to speak for all physical anthropologists, many of whom are either too wise or too timid to speak at all upon this subject, preferring to pursue their researches in academic seclusion, rather than cry their wares in the marketplace and run the risk of being pelted by the rabble. For myself, I prefer to be the target of rotten eggs, rather than to be suspected as a purveyor of that odoriferous commodity.

I therefore intend to assert bluntly and simply what I believe to be the best consensus of scientific anthropological opinion upon what races are and what they connote.

(1) A "race" is a physical division of mankind, the members of which are distinguished by the possession of similar combinations of anatomical features due to their common heredity.

(2) There exists no single physical criterion for distinguishing race; races are delimited by the association in human groups of multiple variations of bodily form and structure—such as amount of pigment in hair, skin and eyes, form of the hair, shape of the nose, range of stature, relation of head length to head breadth, *et cetera*. These criteria are of mainly hereditary origin, but none of them is wholly impervious to environmental influences, such as the effects of climate, diet, exercise and altitude. It follows that race is essentially a zoological device whereby indefinitely large groups of similar physical appearance and hereditary background are classified together for the sake of convenience.

(3) Anthropologists have found as yet no relationship between any physical criterion of race and mental capacity, whether in individuals or in groups.

(4) While it is conceivable that physical races may differ in psychological characteristics, in tastes, temperament and even in intellectual qualities, a precise scientific determination of such differences has not yet been achieved. Such discrimination, if it is possible, must await the development of better anthropological and psychological techniques.

(5) Race is not synonymous with language, culture or nationality. Race is hereditary; language is a cultural acquisition. A Negro may speak English as his native tongue. There is no Aryan race; Aryan is a term applicable only to a family of languages spoken by populations heterogeneous in race, nationality, religion and other aspects of culture. There is no "French race" and no "German race," properly so-called. Such terms imply nationality, use of a common language and some degree of conformity to a pattern of culture, but nothing more.

(6) Physical anthropologists, as yet, are unable precisely to grade existing human races upon an evolutionary scale, upon the basis of the sum total of their anatomical deviations from apes and lower animals. Each race displays a mixture of advanced and primitive characteristics. A definitive rating of the evolutionary rank of each human race presupposes the completion of many anthropological and physiological researches, which, as yet, have not even begun.

(7) A "pure" race is little more than an anthropological abstraction; no pure race can be found in any civilized country. Racial purity is restricted, at best, to remnants of savage groups in isolated wildernesses. The present races of man have intermingled and interbred for many thousands of years, so that their genealogical lines have become inextricably confused. Physical classifications of race merely attempt to delimit groups of approximate physical uniformity, with a restricted assumption of similar heredity.

(8) The composite origin of most of the existing races of man is demonstrable. Thus the Polynesian represents a stabilized blend of White, Negroid and Mongoloid elements. The so-called Nordic race is probably a hybrid derivative of several strains present in Europe during the glacial period, to which have been added in historic times Alpine, Mongoloid and other racial elements (carried by Lapps, Finns, Slavs and other peoples who have mixed with the inhabitants of the "Nordic" area).

(9) The study of the results of hybridization between the most physically diverse of modern races—such as the Negro and the Nordic, or the Mongoloid and the brunet Mediterranean White—has not demonstrated that fertility is decreased, or vitality diminished, by such crossings. The hybrids exhibit a wide range of combinations of features inherited from both parental races, but no degeneracy, provided that both parental stocks are normal. It is probable that racial susceptibilities and immunities to certain diseases are different in hybrids from those obtaining in the parental races, but this subject has been insufficiently studied.

(10) Within each and every race there is great individual variation in physical features and in mental capacity, but no close correlation between physique and mentality has been scientifically demonstrated. Knowledge of human heredity is still far from perfect, and altogether inadequate as a basis for attempts to secure specific combinations of physical and mental features by selective breeding. A scientifically valid program of eugenics, at the present, must be limited to the restriction of breeding among the insane, diseased and criminal, and to the encouragement of reproduction in individual families with sound physiques, good mental endowments and demonstrable social and economic capability.

The scientific method of determining the racial composition of the United States or any other country is to appraise the distribution of type combinations of physical characters in the individual which are known to be hereditary racial features. The sorting of these types is initially made without reference to parentage or national origins of the persons studied. Studies of these physical types in the Old American populations, in the children of immigrants from other countries and in residents of alien birth does not indicate that the racial composition of the United States has been profoundly modified by recent immigrations. Incoming types are virtually identical with those represented in the population resident here for several generations, although the proportions are somewhat modified.

Each racial type runs the gamut from idiots and criminals to geniuses and statesmen. No type produces a majority of individuals from either end of the scale. While there may be specific racial abilities and disabilities, these have not yet been demonstrated. There are no racial monopolies either of human virtues or of vices.

I believe that this nation requires a biological purge if it is to check the growing numbers of the physically inferior, the mentally ineffective and the anti-social. These elements which make for social disintegration are drawn from no one race or ethnic stock. Let each of us, Nordic or Negro, Aryan or Semite, Daughter of the Revolution or Son of St. Patrick, pluck the beam from his own eye, before he attempts to remove the mote from that of his brother. Every tree that bears bad fruit should be cut down and cast into the fire. Whether that tree is an indigenous growth or a transplantation from an alien soil, matters not one whit, so long as it is rotten.

OBITUARY

CHARLES HENRY STANGE

BY the death on April 26, 1936, of Charles Henry Stange, dean of veterinary medicine and professor of veterinary hygiene at Iowa State College, veterinary medicine has lost one of its foremost educators and research directors. He was a native Iowan, born in Cedar County on May 21, 1880, and, while a relatively young man at the time of his death, was recognized as a leader in the field of veterinary medical education.

Only a few months after his graduation from Iowa State College in 1907, he was recalled to accept a position on the veterinary staff. Later he pursued work at the University of Chicago in pathology, which was his field of special interest. In 1909 he was made dean of veterinary medicine at Iowa State College and for twenty-seven years devoted his tremendous energies to problems of educational administration and the development of the oldest state college of veterinary medicine in the United States. His efforts were successful, and upon his death he left as a monument to himself one of the outstanding American colleges of veterinary medicine, together with an affiliated institute for research in animal diseases. The latter, under his direction, has contributed much in recent years to knowledge concerning intestinal and nutritional diseases prevalent in swine and poultry in the Middle West.

Dean Stange's interest in the advancement of professional veterinary medicine was profound, and he recognized that the advancement and recognition were dependent upon the improvement of educational standards in the colleges of veterinary medicine. He spoke and wrote much on the subject, and in 1928 was delegated by the Bureau of Education of the Department of the Interior, Washington, D. C., to conduct a survey of the veterinary colleges of the United States. His report has had much influence upon recent improvement in veterinary educational standards. At the time of his death he was actively engaged as a member of the Committee on Education of the American Veterinary Medical Association in conducting a detailed examination of the veterinary colleges of the United

States and Canada for the purpose of grading and classifying them. Dean Stange was an active worker in various national professional organizations, including the United States Live Stock Sanitary Association and the American Veterinary Medical Association, the latter of which honored him with the presidency in 1924.

Scientist, educator, executive, wise councilor, he will be sorely missed by his colleagues, particularly those at Iowa State College whose purpose it will be to continue building upon the foundations which he has so securely laid in veterinary medical education and research.

H. D. B.

RECENT DEATHS

DR. GEORGE A. HOADLEY, since 1888 until his retirement with the title emeritus in 1914 professor of physics at Swarthmore College, died on May 18 at the age of eighty-seven years.

SAMUEL DICKEN CONNER, research chemist at the Purdue University Agricultural Experiment Station, died on April 19 at the age of sixty-three years.

DR. CHARLES B. GRAVES, retired physician of New London, Conn., and co-author of the "Flora of Connecticut," died on April 24 at the age of seventy-five years.

THE death occurred on May 4 of Dr. Alfred Cardew Dixon, emeritus professor of mathematics at Queen's University, Belfast. He was seventy-one years old.

THE death is announced of Josef Jadassohn, for many years professor of dermatology at the University of Breslau at the age of seventy-two years.

PROFESSOR VLADIMIR G. BOGORAZ, head of the department of ethnography of the University of Leningrad, died on May 12. He was seventy-one years old.

Nature reports the death of L. W. Hinxman, from 1905 to 1919 district geologist in the Geological Survey, Scotland, on April 29, aged eighty-one years, and of Professor D. Morrison, professor of moral philosophy in the University of St. Andrews, who was associated with Professor G. F. Stout in the editorship of *Mind*, on April 8, aged sixty-nine years.

SCIENTIFIC EVENTS

REPORT OF THE BRITISH NATIONAL PHYSICAL LABORATORY

THE report of the British National Physical Laboratory for 1935, published on May 5, is summarized by the London *Times*. The *Times* calls attention to work carried out in the department of physics on the absorption of the radiation from radium by such building materials as brick walls and breeze blocks, the results having direct application in the design of radium departments for hospitals. The department also devoted much time to the study of noise in buildings. In modern flats, it is pointed out, the floor is more important than the walls, because sounds caused by direct impact to the structure are transmitted much more readily than those which have to pass through the air before reaching the structure. The value of a subsidiary floor resting on, and insulated from, the structural floor has been recognized and recent work has been in the direction of improving the design of such floors.

In the tanks of the William Froude laboratory the record number of 73 ships were tested, involving the making of 160 models. Effective improvements were made in 64 of the ships as a result of the tests, and in 13 cases the improvements represented more than 10 per cent. on the fuel consumption and in four cases more than 20 per cent. Research work on small craft was begun in 1934 and has already resulted in a reduction of 30 per cent. in the power required to propel a series of ferry steamers.

In the aerodynamics department recent tests in the compressed air tunnel at the laboratory have proved that the speed of aeroplanes can be considerably increased by insuring that the surface of the wings and other parts is as smooth as possible.

In the electricity department experiments were carried out at the request of the Government of Northern Ireland on the practicability of installing an electric barrage in connection with an important eel fishery. The object is to guide the eels into the part of the river where the traps are installed, by electrifying the water where it is desired to prevent them from passing. These experiments have been extended to more natural surroundings at the Fisheries Experimental Station at Alresford, and it is hoped that full-scale experiments in the eel fisheries of an Irish river will be carried out this year. Experiments in testing colors of electric lights for street lighting were also carried out by the department.

The radio department used for the investigation of atmospherics a base line 300 miles long, one end being at Slough and the other at Leuchars, in Fifeshire. Synchronized automatic drum-recording at each station has been so developed that it is possible to record the results of 30-minutes' observation at 10 yards a second (*i.e.*, 12 miles of track) on a single sheet of paper about one yard long and 4 inches wide. These methods are being used to record the wave-form, intensity and direction of arrival of all the atmospherics occurring in selected intervals of time.

The laboratory is also studying on behalf of the Air Ministry the problem of improving methods of locating the position of an aeroplane by determining the direction of arrival of signals from radio beacons whose situation is known, with particular attention to the elimination of errors in the apparent direction of a transmitter arising from the effects of waves reflected from the upper atmosphere.

In the metallurgy department research on dental fillings was carried out, and in the engineering department research on the fatigue of metals under service conditions has afforded much new and useful information.

A PROPOSED CLOSED SEASON FOR FUR ANIMALS

A FIVE-YEAR closed season for the marten, fisher, wolverine and otter to save them from joining the list of extinct wild animals is urged by Ira N. Gabrielson, chief of the U. S. Bureau of Biological Survey. He states that these fur animals may share the fate of the passenger pigeon, the heath hen, the Maine giant mink and other extinct species unless the hunting and trapping season on them is closed for five years.

Mr. Gabrielson points out that several states have laws providing closed seasons for these animals, but broader protection is needed. They were never very abundant and their pelts always have sold at prices high enough to cause close trapping. They have disappeared entirely from much of their former range.

Resolutions recommending shorter open seasons for taking wild fur animals, and a closed season of at least five years on marten, fisher and wolverine were adopted at the North American Wildlife Conference in Washington, D. C., last February. The otter should also receive special protection as its number is diminishing. However, it still lives in most states largely because trappers find it difficult to locate its haunts.

Trapping female marten and fisher before they bear their young late in March and early April has to a large extent kept these two species from multiplying. The female marten requires about 9½ months to develop its young, and the fisher 11 months. Before this was known it was generally believed to range from 60 to 102 days. This animal lives in the pine forest regions of California, Oregon, Washington, Idaho, Wyoming, Utah, Nevada, Montana, New Mexico, Colorado, Wisconsin, Michigan, New York, New Hampshire, Vermont and Maine.

Fishers may be found in California, Oregon, Washington, Nevada, Wyoming, Montana, Minnesota, Wisconsin, Michigan, Pennsylvania, New York, New Hampshire, Vermont and Maine. Wolverines live in California, Oregon, Washington, Idaho, Montana and Wyoming.

MEETINGS OF THE CHAPTERS OF SIGMA XI

AT the annual meeting and dinner of the District of Columbia Chapter of the Society of Sigma Xi, held at the University Club on May 15, the following were elected to alumni membership and delivered initiatory addresses: Dr. Ralph Edward Gibson, of the Carnegie Institution of Washington, Dr. Paul Renno Heyl, of the National Bureau of Standards, and Dr. Edward Oscar Ulrich, of the U. S. National Museum.

The annual dinner of the Western Reserve University Chapter was held on May 15. Three members from the faculty and eleven from the student body were initiated. The following officers for 1936–37 were installed: *President,* Dr. C. J. Wiggers; *Vice-president,* Dr. J. E. Hyde; *Secretary,* Dr. Edward Muntwyler, and *Treasurer,* Dr. Frank Hvorka. The address was given by Dr. Arthur H. Compton, of the University of Chicago, who spoke on "Cosmic Rays."

The spring initiation and banquet of the Ohio State Chapter will be held at the Faculty Club on the evening of May 29. The address on this occasion is to be given by Professor Griffith Taylor, chairman of the department of geography at the University of Toronto. Professor Taylor's subject will be "Forecasting Settlement in Australia and Canada." Preceding the address 27 members and 31 associates will be initiated into the chapter.

The following officers were elected at the installation ceremonies of the University of Buffalo Chapter, which were held on April 25: *President,* Dr. Wayne J. Atwell, professor of anatomy; *Vice-president,* Dr. Albert R. Shadle, professor of biology; *Corresponding secretary,* Dr. Rufus R. Humphrey, associate professor of anatomy; *Recording secretary,* Dr. Wilson D. Langley, associate professor of biochemistry; *Treasurer,* Dr. Carleton F. Scofield, associate professor of psychology.

Dr. George Howard Parker, professor of zoology, emeritus, at Harvard University, addressed the annual joint meeting of the Washington University Chapters of Phi Beta Kappa and Sigma Xi at St. Louis, Mo., on April 28. He spoke on "The Color Changes of Fishes and the Relation of these Changes to the Action of the Nervous System."

Dr. Robert M. Yerkes, professor of psychobiology at Yale University and director of the Yale Laboratories of Primate Biology, at Orange Park, Fla., gave an address before the Sigma Xi Club of the University of Florida on May 20 on "Anthropoid Apes as the Servants of Man."

The Ohio State Chapter is sponsoring a series of lectures on the general subject of "Hormones." The series was initiated in February with two lectures on "Plant Hormones," the first given by Professor George S. Avery, of Connecticut College, and the second by

Dr. P. W. Zimmerman, of the Boyce Thompson Institute. On April 17 Professor Leon Asher, of Berne, Switzerland, lectured on "Integration by Internal Secretions"; on April 30 Professor C. H. Best, of the University of Toronto, lectured on "Insulin," and on May 6 Dr. W. O. Nelson, of Yale University, lectured on the "Male Sex Hormones." It is planned to continue the series next autumn with lectures by outstanding authorities on other hormones. The series will eventually be published and distributed at cost by the chapter.

THE AWARD OF THE WILLARD GIBBS MEDAL TO ROGER ADAMS

DR. ROGER ADAMS, head of the department of chemistry of the University of Illinois and past president of the American Chemical Society, was presented with the Willard Gibbs Medal for 1936 of the Chicago Section at a dinner on May 22 at the Stevens Hotel, Chicago, in celebration of the twenty-fifth anniversary of the founding of the award by William A. Converse.

President Arthur Cutts Willard, of the University of Illinois, spoke on "The Medalist." Professor Edward Bartow, of the State University of Iowa, president of the American Chemical Society, made the presentation, and Thomas Midgley, Jr., vice-president of the Ethyl Gasoline Corporation, delivered the epilogue. Professor Adams discussed "Organic Chemistry." The history of the Willard Gibbs medal was outlined by Dr. Arthur Guillaudeu, chairman of the Chicago Section. Professor Adams won the medal, one of the highest scientific honors bestowed in the United States, "for outstanding and fundamental contributions to synthetic organic chemistry and for conspicuous achievements as a teacher of chemistry." An account of his work appears in the issue of SCIENCE for January 10. The following statement in regard to his life has been sent us by a correspondent:

Professor Adams was born in Boston on January 2, 1889. He attended the Cambridge, Mass., public schools and entered Harvard College at sixteen, receiving the bachelor of arts degree in 1909 and the master of arts a year later. He took the doctor's degree at Harvard in 1912, having been in charge of all laboratory work in chemistry at Radcliffe College during the first two years of his graduate work. Recipient of a traveling fellowship, he studied under Diels in the University of Berlin and under Willstätter at the Kaiser Wilhelm Institute in Dahlem. He also traveled in Denmark, Sweden, Finland, Russia, Switzerland and England.

From 1913 to 1916 he was instructor in organic chemistry at Harvard University and Radcliffe College. He went to Illinois as assistant professor in 1916, and has been consulting chemist of the Abbott Laboratories, North Chicago, since 1917.

During the war he served as major in charge of an Offense Chemical Research Division in Washington, D. C., where he worked with poison gases. Returning to Illinois as full professor in 1919, he became head of the department of chemistry in 1926.

Professor Adams was a member of the National Research Council Chemical Committee from 1923 to 1928 and a member of its Fellowship Board during the last eight years. He was appointed by President Roosevelt to represent chemistry on the Science Advisory Board and also on the new Government Relations Committee of the National Academy. He holds the honorary degree of doctor of science from the Polytechnic Institute of Brooklyn, and the William H. Nichols Medal of the New York Section of the American Chemical Society. He is a member of many scientific organizations.

AWARD OF THE NATIONAL INSTITUTE OF IMMIGRANT WELFARE TO DR. CARREL

THE first annual National Institute of Immigrant Welfare awards of merit, given to "distinguished citizens of foreign birth who have made significant contributions to American life," were presented on May 13 to Dr. Alexis Carrel, Jonas Lie and Walter Damrosch at a dinner of the institute at Hotel Biltmore. Dr. Harry Woodburn Chase, chancellor of New York University and chairman of the committee on awards, presented to each of the winners a hand-lettered scroll bearing the title "An American Roll of Honor."

Eighteen different countries of origin were represented in the panel of thirty names from which the final selections were made. Dr. Carrel, who was born in France, came to the United States in 1905; Mr. Lie, a Norwegian, came in 1893, and Dr. Damrosch, who was born in Germany, near the Polish border, came in 1871.

In the absence of Dr. Carrel, Dr. Simon Flexner received the award and made the following remarks:

We can all imagine Dr. Carrel's great disappointment in being prevented by illness from accepting in person the distinguished honor you have conferred on him. In his absence, it may be a slight compensation to be told briefly of his eminent scientific career. Dr. Carrel came to America fully thirty years ago, and soon after graduation in medicine at the University of Lyons. He is a splendid example of the French educational system working through a gifted mind. Dr. Carrel's writing even in a foreign tongue such as English is strong, clear and concise, and the scientific problems he selected for experimental study were equally sharply conceived. Dr. Carrel must, as a medical student, have been impressed with the backward state of the surgery of the blood vessels and the serious consequences of this glaring defect. Before his discoveries, to incise or otherwise severely injure a blood vessel was to destroy it: it had either to be ligatured or tied, or allowed to fill with clot to prevent hemorrhage, and was lost.

By means of a technique original, ingenious and precise, Dr. Carrel learned how to suture and save blood vessels, and in consequence for the first time organs *en masse* could be removed from one part of the body and transplanted to another part without loss of function and efficiency. A whole new chapter of physiology or physiological surgery was suddenly opened up for exploration. Among the early rewards was a successful method of blood transfusion, since much simplified, which is daily employed as a life-saving device throughout the world. The recent perfection of the Lindbergh pump, in which organs can be cultivated and observed outside the body for long periods, is a mere, although difficult, extension of the earlier discoveries which in 1912 brought Dr. Carrel the Nobel prize.

Another result of the studies on transplanted organs is the cultivation of cells and tissues of warm-blooded animals in glass. Every one has heard or read of the bit of chicken heart, the artificial cultivation of which was begun more than twenty years ago. Now cells and tissues of the most diverse sort are grown outside the body indefinitely, and their properties can be studied in new ways utterly impossible by the older methods. Thus another chapter in cellular physiology and pathology, thanks to Dr. Carrel, is being written. And as an important side issue the viruses, the causes of many severe diseases in animals and plants, can be made to grow outside the body. These viruses are too small to be seen under the microscope and differ from bacteria in not increasing or growing on dead substances. They can now be studied by implanting them on living, growing tissues in glass.

In conclusion, it may be said that Dr. Carrel has enriched surgery, physiology and pathology through his scientific discoveries and is to be regarded as a benefactor of mankind.

SCIENTIFIC NOTES AND NEWS

DR. ALBERT F. BLAKESLEE, director of the department of genetics of the Carnegie Institution of Washington at Cold Spring Harbor, L. I., has been elected a foreign member of the Royal Danish Academy of Science.

THE following have been elected correspondents of the Academy of Natural Sciences of Philadelphia: Ernst V. Antevs, John H. Barnhart, Thomas Barbour, Calvin B. Bridges, Andrew E. Douglass, Richard Goldschmidt, Shinkishi Hatai, J. Hutchinson, Paul Marchal, Mary J. Rathbun, R. B. Seymour Sewell, Hans Spemann, Erik H. O. Sensiö, Erwin Stresemann, Francis B. Sumner and Thomas H. Withers.

M. JEAN BOSLER, professor of astronomy and director of the observatory at Marseilles, has been elected a correspondent of the Paris Academy of Sciences in the section of astronomy, to succeed the late Professor Willem de Sitter.

DR. THEODOR HESSELBERG, director of the Norwegian Meteorological Institute at Oslo, has been elected a corresponding member of the Prussian Academy of Sciences.

THE Elisha Kent Kane Gold Medal of the Geographical Society of Philadelphia was presented to Lincoln Ellsworth at the annual dinner of the society on May 15. Francis Fisher Kane, a nephew of Elisha Kent Kane, made the presentation.

Nature reports that the council of the Royal Society of Edinburgh has awarded the Keith Prize for the period 1933–35 to Professor Lancelot T. Hogben, for his papers on genetical subjects published during the period of the award; and the Neill Prize to Dr. Samuel Williams, University of Glasgow, for his contributions to the anatomy and experimental morphology of the Pteridophyta.

THE honorary degree of doctor of science will be conferred upon Dr. Lawrason Brown, consulting physician of the Trudeau Sanatorium, Saranac Lake, N. Y., at the commencement exercises of the Medical College of the University of Virginia.

THE American Psychiatric Association, meeting at St. Louis on May 6, chose Dr. Ross McC. Chapman, of Towson, Md., as president-elect to take office in 1937. He succeeds Dr. C. Macfie Campbell, of Boston, who took office as president. The retiring president was Dr. Clarence O. Cheney, of New York. Dr. Siegmund Freud, of Vienna, was elected to honorary membership.

DR. DUNCAN A. MACINNES, since 1926 associate member of the Rockefeller Institute for Medical Research, was elected president of the Electrochemical Society at the recent Cincinnati meeting. He succeeds James H. Critchett, of the Union Carbide and Carbon Research Laboratories, New York City.

DR. R. R. KRACKE, of Emory University, Georgia, was elected president of the American Society of Clinical Pathologists at the recent Kansas City meeting.

DR. H. A. CARR, professor of psychology at the University of Chicago, was elected president of the Midwestern Psychological Association at the annual meeting, which was held at Northwestern University on April 24 and 25. Professor J. P. Guilford, of the University of Nebraska, was elected a member of the executive council.

PROFESSOR HARRY P. BURDEN, of the department of civil engineering at Tufts College, has been appointed

dean of the School of Engineering. He succeeds Professor Emeritus George P. Bacon. Frederick H. Crabtree, instructor in the department of civil engineering, has been named assistant dean, to succeed Professor Jamison R. Harrison, who has become head of the department of physics.

THE following promotions in the Harvard faculty have been announced: Dr. Gordon W. Allport, from assistant professor to associate professor of psychology; Dr. Philip Drinker, from associate professor to professor of industrial hygiene, and Jacob P. Den Hartog, from assistant professor to associate professor of applied mechanics.

PROMOTIONS have been made at Brigham Young University as follows: Dr. Thomas L. Martin, professor of agronomy and bacteriology, has been made acting dean of the College of Applied Science; Assistant Professor Joseph K. Nicholes has become associate professor of chemistry, and Dr. Hugh W. Peterson has been appointed assistant professor of chemistry.

DR. A. R. MCINTYRE, at present professor of physiology and pharmacology, has been appointed chairman of the department of physiology and pharmacology in the College of Medicine of the University of Nebraska in Omaha.

HAROLD B. SHATTUCK, professor of railroad engineering at the Pennsylvania State College, will retire at the close of the academic year. He has been a member of the faculty for thirty-five years.

PROFESSOR FRED C. SEARS, head of the department of pomology at the Massachusetts State College, will retire from active teaching in June. He has been a member of the faculty since 1907 and this spring passed the mandatory retirement age of seventy years set by state law.

DR. HELLMUT DE TERRA, since 1933 assistant professor and research associate in geology at Yale University, has become a research associate of the Carnegie Institution of Washington. He will carry on his work at the Museum of the Academy of Natural Sciences at Philadelphia.

Nature states that pending the appointment of a successor to the late Sir Joseph Petavel, the office of director of the National Physical Laboratory will be held by Sir Frank Smith, the secretary of the Department of Scientific and Industrial Research.

PROFESSOR I. M. KOLTHOFF, head of the division of analytic chemistry at the University of Minnesota, will give early in June a series of lectures at Charles University, Prague. Later, he expects to stay at Almelo, Holland, until the middle of August.

DR. GEORGE W. CORNER, professor of anatomy at the University of Rochester School of Medicine, lectured on May 13 on "The Hormone of the Corpus Luteum," before the Medical Society of Yale University.

THE annual series of lectures by a visiting zoologist at the University of Minnesota was given this year by Dr. W. W. Cort, of the School of Hygiene and Public Health of the Johns Hopkins University. Dr. Cort gave the following three lectures: "Problem of Swimmer's Itch"; "Parasitic Diseases in Egypt in Relation to Village Life and Agricultural Practices," and "Experimental Studies on Hookworm."

DR. CLINTON L. UTTERBACK, professor of physics and member of the staff of the Oceanographic Laboratories of the University of Washington, has been invited to take part in the symposia on "Submarine Radiation" at the annual meeting of the International Council for Exploration of the Sea, to be held in Copenhagen, Denmark. Dr. Utterback has also received a travel grant from the Association Internationale d'Oceanographie Physique of the Union Geophysique Internationale to enable him to consult with investigators in various laboratories of northern Europe in connection with his work on solar radiation.

SIR RICHARD GREGORY delivered on May 15 a lecture entitled "Science in a Changing World: Recollections and Reflections," at the Royal Institution, London.

LORD RUTHERFORD has been elected the twelfth annual Norman Lockyer lecturer of the British Science Guild. The date of the lecture has been fixed for November 12.

THE International Conference on Soil Mechanics and Foundation Engineering will meet in Cambridge, Mass., from June 22 to 26. A bulletin containing detailed information on this conference will be mailed on request.

THE third International Light Congress will be held at Wiesbaden, Germany, from September 1 to 7. The chief subjects for discussion will be the measurement of radiation, the biological effects of radiation and radiation therapy. The president of the congress is Professor W. Friedrich, of the Institut für Strahlenforschung, Berlin. Detailed information in regard to the congress can be obtained from Dr. Janet H. Clark, of the School of Hygiene and Public Health of the Johns Hopkins University, Baltimore, and from Dr. W. W. Coblentz, Bureau of Standards, Washington, D. C.

THE two hundred and sixth regular meeting of the American Physical Society will be held at the University of Washington, Seattle, on June 17, 18 and 19.

On Wednesday morning there will be an X-ray Symposium, at which Dr. F. K. Richtmyer, Dr. J. W. M. DuMond, Dr. R. R. Newell and F. Bloch will speak. On Wednesday afternoon there will be a joint meeting with the Astronomical Society of the Pacific. Contributed papers will be presented on Thursday morning and there will be a joint session with the American Mathematical Society, at which Dr. H. P. Robertson will speak on "Geometry and Physical Space Time." On Friday morning there will be invited addresses by Drs. O. E. Buckley and George Gamow. The two hundred and seventh meeting will be held at Rochester, N. Y., on June 22 and 23.

THE Genetics Society of America will hold a summer meeting at Woods Hole on September 4 and 5. The program will consist of two round-table conferences and one session of demonstration papers. R. A. Emerson, of Cornell University, will be the leader of the conference on "The Nature of Mutations." The subject will be introduced by R. A. Fisher, of the Galton Laboratory, London, and L. J. Stadler, of the Bureau of Plant Industry, Columbia, Mo. The second conference, dealing with "Progress in Cytogenetics," will be in charge of Karl Sax, of Harvard University. C. L. Huskins, of McGill University, and C. B. Bridges, of the Carnegie Institution of Washington, will act as introducers. On September 3 an evening lecture will be given by Th. Dobzhansky, of the California Institute of Technology, on the "Genetic Nature of Specific and Racial Differences."

IN some of the metropolitan newspapers of May 4 was a report of grants made by the "American Philosophical Society held in Philadelphia for the promotion of useful knowledge," which is unfortunately in error in stating that $160,000 had been granted to 53 applicants in the past year. During the past year and a half 53 grants were made of a total amount of $78,150. Since the organization of the Committee on Research, three years ago, 98 grants have been made of a total sum of $147,670.

AN appropriation of $3,354,722 has been made by the Rockefeller Foundation and the General Education Board to the University of Chicago for the Oriental Institute. Of the appropriation, $1,354,722 represents the unexpended balance of a ten-year grant made by the two foundations in 1928 to finance expeditions in the Near East. The other $2,000,000 is a new gift, which may be used for such purposes as the institute and the university may determine.

CORNELL UNIVERSITY has received from the Rockefeller Foundation a grant, amounting to $42,500 over a period of six years, to assist studies being carried out by Drs. L. A. Maynard, C. M. McCay and S. A. Asdell, and dealing with "The Influence of Diet upon the Physiological and Biochemical Changes which Accompany Aging in the Animal Body." These studies are being conducted in the Laboratory of Animal Nutrition at Ithaca. A correspondent writes: "In studies initiated by Dr. McCay some six years ago it was found that rats which grew at a maximum rate as measured by weight and size had shorter life spans than those which grew more slowly as a result of a restricted calorie intake. These experiments have also provided material for comparative chemical and histological studies of the changes which occur during the aging of animals fed rigidly controlled diets throughout life. Since most nutrition experiments have dealt with the young and growing organism over a comparatively short period of the life span, the Cornell workers are studying the influence of dietary variables imposed during the last half of life, in the belief that the dietary factors concerned in the retardation of senile changes may be different from those which promote optimum development during the ascending period of life."

THE Akeley Memorial Hall of African Mammals at the American Museum of Natural History was dedicated on May 19 in ceremonies open only to members of the museum. The dedication, which marked the birthday anniversary of the late Carl E. Akeley, for whom the hall was named, was attended by more than 2,000 members of the museum.

Industrial and Engineering Chemistry reports that Mrs. Caroline Strong Newell, wife of the late Lyman C. Newell, has presented to the College of Liberal Arts of Boston University Professor Newell's valuable collection of books, prints, letters, manuscripts and medals relating to the history of chemistry. The collection has been arranged for safe keeping and display in a special room, and is to be known as the Lyman Churchill Newell History of Chemistry Collection. The room contains Professor Newell's portrait, his desk, chair and bookcases, also presented by Mrs. Newell. Prints, manuscripts and other memorabilia pertaining to particular chemists have been collected in folders and filed alphabetically in a filing cabinet. Professor Newell's library is also contained in the room.

THE Charles Lathrop Pack Trust has made available to Cornell University three thousand dollars to be used in supporting one or more fellowships in the field of nature education at the graduate level. Portions of this fund will be used in financing travel incident to the studies which presumably will center about the growth of conservation education and the problems associated with its introduction in the school program. Candidates should be well qualified in allied sciences as well as in the professional field and presumably

should be persons with teaching experience and at least a year of graduate work. Inquiries should be addressed to Professor E. L. Palmer, Cornell University, Ithaca, N. Y. Appointments may be made by July 1.

ORGANIZATION of the Lalor Foundation for the advancement of natural scientific research and encouragement of the arts was effected at Wilmington, Del., on May 11, and the announcement made that in the fall five professorship and fellowship grants of $2,500 each will be available. The foundation was organized as a Delaware corporation following receipt of a bequest of $400,000 from the estate of Willard A. Lalor, a former official of the Chicago, Burlington and Quincy Railway. The bequest is a testimonial to his sister, Mrs. Anna Burdick, of the U. S. Department of Education, and to his brother, John C. Lalor, who was prominently identified with the early development of the mining and metallurgical industries in Montana. It is stated that the foundation considers the encouragement of outstanding young men to continue work in purely scientific research after they have completed their graduate training to be a desirable object. Consequently, current awards will be for the support of purely scientific research and for fellowships in specified fields. They will be given to mature scholars of demonstrated ability and will afford recipients the "freest possible conditions for study."

SIR HERBERT AUSTIN, British motor manufacturer, has given £250,000 to the Cavendish Laboratory of Experimental Physics at the University of Cambridge. Prime Minister Stanley Baldwin, as chancellor of the university, in a letter to Sir Herbert acknowledging the gift, wrote as follows: "There can be no greater encouragement to the men who devote themselves to scientific research than to feel that their work is appreciated by those engaged in industry, the progress and development of whose businesses depend so much on the laboratories of our country. Your noble gift will be invaluable at this time to Cambridge and the benefits arising from its applications will be available for the civilized world."

THE Louisiana State University Zoological Field Laboratory will hold its sixth season from June 8 to August 5 at Grand Isle, La., for the first time with a building and land of its own. A survey of the local fauna, as well as formal course work, is planned. Dr. Ellinor H. Behre will be in charge of the work.

THE New York State Experiment Station at Geneva, cooperating with the New York Botanic Garden, announces the development of a new seedless grape which has been named "Bronx Seedless." The new variety represents sixteen years of effort to obtain a seedless grape that at the same time is hardy to New York conditions.

THE *British Medical Journal* notes that the *Nederlandsch Tijdschrift voor Geneeskunde* contains illustrations of eighteen postage stamps showing figures of physicians, including Imhotep, Boerhaave, Haller, Schiller, Semmelweis, Calmette and Ramon y Cajal.

DISCUSSION

SILVER SPRINGS AND THE FLORIDA SHIP CANAL

DURING recent weeks newspapers have referred frequently to the bitter controversy concerning probable effects of the projected Florida Ship Canal upon the ground-water supply of central and southern Florida. Occasional reference has been made to famous Silver Springs and Blue Spring in Marion County, and conflicting statements have been made as to their chances of surviving the digging of a sea-level canal. Scientists and lovers of the beautiful and marvelous in nature have reason to inquire whether these two natural wonders are to be sacrificed for a canal, the benefits of which may still be regarded as problematical. The writer has followed discussions of the proposed canal for some time, and it appears that the question of its probable effects upon these springs can be isolated from the larger problem of possible wholesale injury to Florida's ground-water resources and that possibly the effects upon the springs can be predicted with some degree of assurance. For that reason the following notes have been compiled, and a tentative interpretation is offered. It is believed that with the facts and maps available others may enjoy drawing their own conclusions, which, of course, may or may not agree with those of the writer. All the facts offered herein have been gleaned from the maps and reports of the Florida and United States Geological Surveys, or from various reports prepared in connection with the study of the selected route.

Silver Springs and Blue Spring occur within the outcrop area of the Ocala limestone. The Ocala, a formation of Eocene age, is believed to reach a thickness in excess of five hundred feet. It underlies all Florida in a gentle and elongate dome conforming roughly in shape and orientation to the form of the peninsula. This limestone is extremely porous and cavernous and is the foremost aquifer in Florida. It may be described as honeycombed with underground channels, and its outcrop areas are characterized by springs, lakes and sinkholes. There are probably few

limestones through which water will pass more readily, and for that reason the water table tends to be rather even and lacking in marked slopes.

Silver Springs, about five miles northeast of the city of Ocala, is shown on the Ocala sheet of the Topographic Atlas of the United States, to which the reader may wish to refer. It is the largest spring in Florida and is said to be the largest spring in limestone in the United States. According to the United States Geological Survey, about 500,000,000 gallons of water, approximately the amount of water used by New York City, flows from Silver Springs each day. The water is discharged into a basin about 35 feet deep and flows by way of Silver Springs Run, a stream having a maximum depth of eleven feet, to the Oklawaha River four miles to the east. The water surface of the springs is stated to be 40 feet above sea level, a figure closely approximating the average elevation of the water table for a considerable area of the surrounding country.

According to the map prepared for the Report of the Board of Review, June 28, 1934, the selected route for the proposed canal bears north 40 degrees east from the hamlet of Santos, south of Ocala. If this course is plotted upon the Ocala sheet, the route is seen to pass off the eastern edge of the map, east of Ocala, and almost exactly three and one half miles southeast of Silver Springs. Here it passes through the extensive Dead River Swamp, the surface of which lies 30 to 40 feet above sea level. The present difference in elevation between the water table at Silver Springs and at the indicated line is thus less, possibly several feet less, than ten feet in three and one half miles.

The proposed canal is to be a cut excavated to a minimum depth of 30 feet below sea level. While possibly no one may predict the exact effects, the following is suggested as perhaps a reasonable interpretation. Along the line of the canal the water table can with confidence be expected to drop to water level, which will be practically sea level. In the course of time, possibly rather rapidly because of the extremely cavernous nature of the Ocala limestone, and because water will escape readily into the cut not only above sea level, but also below as submarine springs, a new upper level of ground water will be established. Dead River Swamp will probably be drained. If the difference in elevation between the water table surface at the springs and at the canal becomes the same as the present difference between the surface at the springs and at Dead River Swamp along the selected route, it is clear that the water table will have an elevation of about ten feet at the Springs—in which case the springs would become a sink with a pond in the bottom, and the run an abandoned channel. It is possible that there would be a greater difference between the elevation of the water table at the two points, and if so, the springs would not be so seriously affected. The general effect, however, might still be the same.

It appears futile to suggest, as has been done by some without geological training, that a dam across the run will save the springs, for, if the described effect occurs, the water will be drawn off underground. It is interesting to note that the canal map mentioned earlier shows a hydro-electric plant with a reservoir on Silver Springs Run as one of the subsidiary projects in connection with the canal.

Conditions at Blue Spring differ only in degree from those at Silver Springs. For the best appreciation of local conditions reference should be made to the Dunnellon sheet, which shows a characteristic area of limestone sinks developed upon the Ocala formation. In volume of flow Blue Spring is comparable to and second only in Florida to Silver Springs. According to the United States Geological Survey its surface is also 40 feet above sea level. It is situated about four miles northeast of the village of Dunnellon and is drained southward to the Withlacoochee River at Dunnellon by Wekiwa Creek, a stream about five miles long. The 20-foot contour line crosses the Withlacoochee River just west of the railroad bridge at Dunnellon, so that the water level of the river four to five miles south of the spring is slightly, possibly two or three feet, over 20 feet. The difference in elevation of the water table at the spring and at the river is thus about 20 feet, and ground water in the area of the spring may be assumed to drain toward the river.

Reference to the map prepared for the Board of Review indicates that the selected route crosses this area on a line running directly from east to west through Dunnellon. It passes almost exactly four miles south of Blue Spring. Again it seems fair to assume that in the course of time the water table along a canal dug to 30 feet below sea level would drop to sea level, 20 feet lower than at present. The present water table would certainly be thrown out of equilibrium, and the rapidity with which the adjustment would be made would depend largely upon the perfection of the system of underground channels. If the water table at the spring should maintain the same relationship to that in the canal, as it now does to the water of the Withlacoochee, it would be about twenty feet lower than at present. These effects might not immediately become apparent, but in due course of time the water table would surely be lowered into a position of greater equilibrium. It is interesting to note that a hydro-electric plant is also proposed for the outlet of Blue Spring.

The writer is not prepared positively to assert that these springs will be destroyed or seriously damaged,

but the opinion that the available facts point toward that conclusion is advanced with some assurance.

HENRY S. SHARP

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THE TOXICOGENIC AND TOXINIFEROUS INSECT[1]

THE increasing recognition of purely toxic effects of insect feeding as contrasted with those wherein a virus is concerned suggests the desirability of terms to describe those insects whose feeding results in pathological effects not ascribable to mere mechanical injury and not fulfilling the criteria necessary to establish the presence of a virus.

Possibly the simplest cases of such effects are to be found in the leaf spotting caused by the feeding of scale insects and leafhoppers. The leafhopper burns are more complicated, since the symptoms are not localized at the insects' feeding points and there is evidence of some diffusion of the toxic principle.

Systemic toxic effects are more rare, but psyllid yellows of potatoes and mealybug wilt of pineapples are cases in point.

Although these several types vary greatly in complexity, one characteristic is common, *i.e.*, all are specific toxic effects and the capacity to produce them is inherent in the insects concerned. These insects may therefore be described as "toxicogenic" species. A toxicogenic insect may, however, not always be capable of secreting toxins, since such toxins may only arise as a result of specific or limited nutritional conditions. To describe the active toxin-secreting condition of a toxicogenic insect the term "toxiniferous" is proposed.

This latter term was first used, without amplification, in a recent paper, "Mass Action Phenomena in Mealybug Wilt,"[2] to describe the mealybug species, *Pseudococcus brevipes* (Ckl.). The more restricted use of the word "toxiniferous" and the introduction of the term "toxicogenic" will serve a useful purpose in the clarification of these concepts.

WALTER CARTER

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HONOLULU, HAWAII

VAGAL AND SYMPATHETIC ENDINGS IN THE RABBIT INTESTINE[1]

WE have previously reported[2] that section of the vagi and the splanchnic nerves below the diaphragm does not alter the response of excised segments of the small intestine to epinephrine, physostigmine, acetylcholine, nicotine or barium or to electrical stimulation of the mesenteric nerves. These observations afforded evidence for the preganglionic nature of the splanchnic and vagus fibers to the intestinal muscle. Further experiments have now shown that cutting the mesenteric nerves, with subsequent degeneration of the fibers, sensitizes the longitudinal muscle coat to the inhibitory action of epinephrine. Responses of the muscle to nicotine, physostigmine, acetylcholine and barium were unchanged. Thus has been obtained pharmacological confirmation, approaching proof, of the anatomical studies of Johnson[3] indicating that the vagus nerves end on the ganglion cells of the Auerbach system; the axones of these ganglion cells therefore constitute the postganglionic fibers of the vagus pathway to the gut muscle. The sensitization of the muscle to epinephrine as a result of sympathetic fiber degeneration indicates that the sympathetic fibers in the mesentery end directly on the muscle and are not relayed through the Auerbach ganglia. It is a well-known fact that smooth muscles are sensitized to epinephrine by degeneration of their postganglionic sympathetic nerve supply. Conversely, physostigmine response of the iris disappears, following degeneration of the postganglionic fibers, but not of the preganglionic fibers of the ciliary ganglion.

These experiments firmly establish the vagal nature of the cells of Auerbach's ganglia of the rabbit but do not rule out their possible secondary rôle for local reflexes in the intestine.

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LATRODECTUS GEOMETRICUS KOCH IN SOUTHERN FLORIDA

THE presence of the black-widow spider, *Latrodectus mactans* Fab. in Florida has long been recognized. It has not been particularly abundant in southern Florida, but specimens are taken with regularity, and occasionally word is received from some physician that a patient suffering from the bite of this spider has been treated by him.

Early in September, 1935, several spiders with cocoons were collected in their nests on one of the university buildings by certain students engaged in making repairs. A study of these specimens by the writer indicated that they belonged to the genus *Latrodectus,* but variations in markings, the presence of a variable amount of buff or brown in the general coloration of the specimens and the larger, tuberculated egg

[1] Published with the approval of the director as Miscellaneous Paper No. 17 of the Experiment Station of the Pineapple Producers Cooperative Association, University of Hawaii.

[2] *Ann. Ent. Soc. of America,* 28 (3): 396–403, September, 1935.

[1] Supported in part by grants 194 and 236, Committee on Scientific Research, American Medical Association.

[2] F. S. Modern and C. H. Thienes, *Jour. Pharm. Exper. Ther.,* 51: 128 (Proc.).

[3] S. E. Johnson, *Jour. Comp. Neur.,* 38: 299.

case, together with other differences, led him to believe that they could not be *L. mactans* as known in this region. Other additional specimens were taken outside the building, usually on doors or under window sills, and some of these were sent to Dr. W. J. Gertsch, of the American Museum of Natural History, for identification.

They were classified by him as the first records of *Latrodectus geometricus* Koch to be taken in the eastern part of the United States. Dr. Gertsch states that they are tropicolitan in distribution and cites records of their occurrence as the dominant form of *Latrodectus* in Brazil, of their abundance in the West Indies, in Africa, and of their occurrence in California.

Within the past few months Mr. Henry Louis and Mr. John Carroll, students in the botany and zoology departments of the University of Miami, have taken numerous specimens of this species in various localities in the Miami region.

The abundance of the species would indicate that it is perhaps the dominant form of *Latrodectus* in southern Florida. While Dr. Gertsch in a personal communication quotes Drs. Brazil and Vellard as regarding its venom as of almost equal potency with that of *L. mactans,* he also quotes them as believing that, despite the inconclusiveness of their experiments, the venom of *L. geometricus* may be less active.

Our observations so far agree with theirs in that the species appears to be less aggressive than *L. mactans.* Indications point to a far greater activity of this species at night than in the daytime.

The writer can not at this time be certain that some records of persons being bitten by the "black-widow" in this region may not more correctly indicate that they have suffered from the venom of *L. geometricus.*

JAY F. W. PEARSON
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SCIENTIFIC BOOKS

The Pioneer Century of American Entomology. By HARRY B. WEISS. Published by the author. New Brunswick, N. J., royal 8vo., pp. 320, $4.25. Edition limited to 150 copies.

DR. GEORGE SARTON and the increasing number of people interested in the history of science will like this book because it is admirably done. It seems rather a pity that some commercial publishing firm did not print it, because then the book would have had fifty or more illustrations. But they all thought that it would not be profitable. The University Presses wanted the book to be subsidized, and the foundations had no funds. This, Mr. Weiss tells us in his "postface"; but obviously he was very sure of the usefulness of the book on which he had put so much time and work that he, with great enterprise and I think with much wisdom, published it himself. He did this by having the book beautifully mimeographed, printed an attractive title page and had it all bound in a solid, very attractive binding of brown cloth with gilt lettering, so that it looks mighty well on one's shelves. But many of us will not put it away on our shelves—we'll keep it on our desks for reference and for very careful reading.

I believe it to be true that the younger men in this and other branches of biology to-day are not especially bookish; at all events they are not precisely "book-minded." Several old professors with whom I have talked recently have told me that this is true. And as for young men who spend hours in the library looking up the things that men of their grandfather's generation did—they do not exist nowadays. Take Weiss in New Jersey, Essig in California, Wade in Washington, S. W. Geiser in Texas and T. S. Palmer in Washington—all of whom occur to you at once, and then try to think of others of the same turn of mind. I can't do it. Perhaps you can.

It is true that these five men have all reached a certain age. I am sure that other men, as they grow older, will measurably take their places. Weiss comments delightfully on this age question. He says in the closing sentence of the preface: "And so this book has been written, if you please, because I have reached a certain age. It was unavoidable."

The author covers his ground in twelve chapters, beginning with "Entomology in the Accounts of early Travellers," and carrying it on by periods ending with 1865; and then he adds chapters on entomology in the agricultural periodicals of the period, on scientific societies and journals, some notes from Canada, and on entomology in Europe during the pioneer century in America. After this last chapter come the acknowledgments, a "postface," a bibliography and a very competent index.

One beauty of the book is that he tells us a lot of things that we wanted to know and that we didn't know how to find. For example, when I was in my very early twenties, I wrote a long chapter in the big report on cotton insects published by the U. S. Department of Agriculture in 1879. This chapter was on the past history of the "cotton worm" and it went way back into the 1700's and quoted many men. Ever since that I have wanted to know about Thomas Affleck and D. B. Gorham and Dr. W. I. Burnett, and a lot of other early men who had published their speculations. Here, wherever possible, Weiss has given us full in-

formation about these men. And there were very many of them. Then, too, it is most interesting to find that several of one's collateral ancestors once wrote something about insects or about some one insect, and most of us need facts of that kind to bolster up a faith in the inheritance of scientific tastes. Dr. Davenport will please note.

But these items to which I refer deal with injurious insects, while the book covers the whole field of entomology. Many of us have failed to realize how very much was done in that "pioneer century." The very good index to this book has over 600 entries, and I estimate that 500 or more of these are the names of persons who had published (prior to 1865) something on insects, and who receive longer or shorter notices in the volume. We can learn all about the Melsheimers, about Thomas Say (on whom Mr. Weiss has written a separate book), and the many writers who followed—most of them taxonomists like Bassett, Blake, Bland, Burgess, Clemens, Cresson, Crotch, W. H. Edwards, Grote, Hagen, J. G. Morris, LeConte and Norton—and nearly all the other amateurs. Several great names, like those of Packard and Scudder, carry us on from that pioneer century into the next, beginning with 1865; but the early careers of such men are described by Weiss.

But there were writers other than taxonomists and those who wrote about remedies. S. S. Haldeman was one of the best of these, and they are all mentioned. And one's curiosity is fully satisfied about such an interesting character as Benedict Jaeger, whose readable, but rather unscientific and useless book called "Life Histories of American Insects" was read and really enjoyed by the boys of my generation. Weiss tells his whole story rather fully. Then, too, he tells all about Frank Cowan, the newspaper man who found himself stranded in Washington during the Civil War, and who went to the Congressional Library and dug out the material for his "Curious Facts in the History of Insects," a book that has been more quoted than any other insect book that was ever written in the United States.

And the way the author has done the work—with what industry and care! One can not praise it too highly. He writes wonderfully well. I suppose that is because he writes as he thinks and talks. It is so much easier to read a well-written book. Isn't it?

L. O. HOWARD

The Invertebrata. A Manual for the Use of Students. By L. A. BORRADAILE and F. A. POTTS, with chapters by L. E. S. EASTHAM and J. T. SAUNDERS. Second edition. New York: The Macmillan Company. Cambridge, England: at the University Press. 1935. THE second, revised edition of this manual, published only three years after the first edition, is of itself sufficient evidence of the need of just such a text. It fills an important gap between short textbooks for beginners and much larger manuals for advanced students. As the note on page vi states, "the book is now eighty pages longer" and "each chapter has been revised by its writer." In other respects the book follows the original plan and deals almost entirely with the morphology and classification of phyla into classes and orders with some references to sub-orders and representative genera. In general, the subject is handled in an excellent manner and the chapters written by Borradaile are almost above criticism. Unfortunately this can not be said about the work of the other collaborators. The chapter on Ctenophora written by Saunders is much too short and quite inadequately treated, considering the interest attached to this group from a comparative and an experimental point of view. The same criticism applies to chapters VII (Nemertea, Rotifera and Gastrotricha), and XV (Arachnida) written by Potts. The space allotted to different classes in the latter is not well apportioned, the text has not been revised and serious errors have not been corrected. Thus on page 530 in the description of the anatomy of spiders no less than seven misstatements are made, which could have been easily avoided. In the section on Tardigrada the correct statement on page 468 of the first edition, "Physiologically they are interesting in their capacity for resisting desiccation," has been "revised" in the second edition on page 541 to read "Physiologically the *Pantopoda* (italics mine) are interesting in their capacity for resisting desiccation." The author, of course, did not mean it and intended to say *Tardigrada* instead of *Pantopoda*, but since the change was not needed, the slip is highly unfortunate. There are some incorrect statements as, for example, in the chapter on Oligochaeta, in which on page 287 the author lists among the characters found in "the primitive forms in all families" the presence of a gizzard and a typhlosole, whereas, as a matter of fact, some worms do not possess them. In some cases the description of an organ is misleading, if not strictly speaking incorrect. Thus on page 195, referring to the aboral sense organ of Ctenophores the author states that it is "formed of small round calcareous bodies" . . . etc. Now these bodies are merely supported by the processes of the sense cells and are necessary for the proper function of the organ, but do not *form* the organ. In other places there are discrepancies in the text. For example, on page 517, concerning the distribution of respiratory organs in Arachnida the author makes the following statement: "(2) 'Lung books' in the terrestrial scorpions and Pedipalpi. (3) A combination of lung books and tracheae in the spiders. (4)

Tracheae alone in the solifugae, Pseudoscorpionioidea, Phalangida and Acarina." But on page 519 he mentions the presence of two pairs of lung books and no tracheae in the spider families Atypidae, Liphistiidae and Aviculariidae, and the presence of only tracheae in the Family Caponiidae.

Notwithstanding the inconsistencies and shortcomings pointed out above, the book is more complete and better than several other texts and may be well recommended for use in colleges and universities. It is to be hoped that errors will be eliminated in the next edition.

ALEXANDER PETRUNKEVITCH
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SOCIETIES AND ACADEMIES

THE TENNESSEE ACADEMY OF SCIENCE

THE spring meeting of the Tennessee Academy of Science was held on Friday and Saturday, April 17 and 18, at the Tennessee Polytechnic Institute, Cookeville, Tennessee. Two sessions were held on Friday and one on Saturday morning, the president of the academy, Dr. Claude R. Fountain, presiding. Friday evening, in the auditorium, following a dinner in the cafeteria, there was an address of welcome by Q. M. Smith, president of the institute, and a lecture by Dr. William S. Webb, head of the department of physics, University of Kentucky, Lexington. The subject of Dr. Smith's lecture was "A Discussion of an Archeological Survey of Norris Basin." The lecture was illustrated and of especial interest as, owing to the overshadowing importance of the economic and social features of the development of the Norris Basin, the public has given little attention to the archeological exploration. Saturday afternoon many of the members went on a botanical excursion, led by Professor D. R. Bartoo, to Stamp's Hollow.

Friday afternoon, Dr. Clinton S. Baker, associate director and resident biologist of the Reelfoot Lake Biological Station, read a paper by Dr. A. Richard Bliss, director, on the work to be done at the station next summer, and then explained the requirements for research scholarships offered by the academy, the number to be limited to about twelve. Ten applications had already been received, he said.

The success of the meeting at Cookeville, a town in the highlands on the border of the Cumberland Plateau, lends support to the policy of the Tennessee Academy of Science to hold a meeting at some point in the state in the spring in addition to the regular meeting in the fall at Nashville.

The sentiment of the forty members of the academy attending the meeting was well expressed in a motion by Dr. Bircher, adopted unanimously, that the Tennessee Academy of Science extend to the Tennessee Polytechnic Institute, to Dr. Dicus and the members of the committees who have arranged this meeting, a vote of thanks for the facilities of the institute so graciously placed at our disposal, for the friendly hospitality shown the members of the academy and for the splendid program of papers and lectures.

J. T. MCGILL

THE TEXAS ACADEMY OF SCIENCE

THE Texas Academy of Science held a regional meeting in conjunction with the eleventh annual meeting of the West Texas Historical and Scientific Society, an affiliated organization, at Alpine, Texas, on April 10 and 11. The occasion of the joint meeting was the laying of the corner-stone of the museum building, which is to be the home of the Historical and Scientific Society. This pretentious building is being erected on the campus of Sul Ross State Teachers College and is built of native rock. The museum building is to be not only a depository for the records of the historical and scientific achievement but will contain laboratories, preparation rooms and other facilities for individual investigators, especially those who come from a distance. Here ample provision is being made for the investigator to have those advantages which are so necessary to field work. The program was presided over by Frederick A. Burt, secretary of the Texas Academy of Science; H. B. Parks, secretary emeritus, acted as secretary. A program consisting of twelve numbers was given. The notable papers were: "Light from the Midnight Sky," by Dr. C. T. Elvey, in charge of the new McDonald Observatory which is now under construction on the summit of Mount Locke about forty-five miles from Alpine; "The Geology of the Chisos Mountains," Dr. Charles M. Gould; and a lecture on "Sulphur," by Dr. J. C. Godbey, past president of the academy.

A visit was made to the observatory and the visitors were shown through the empty dome which awaits the telescope. They were also shown the apparatus on which the work in astral physics is now being done. A combined field trip under the direction of Henry Fletcher, president of the West Texas Historical and Scientific Society, Dr. O. W. Sperry, Sul Ross Teachers College, V. L. Cory and H. B. Parks, of the Experiment Station, visited the Glass Mountains. One of the important actions was the making of plans for holding the meeting of the Southwestern Division of the American Association for the Advancement of

Science in connection with the Historical and Scientific Society and the Texas Academy of Science at Alpine in 1938.

SAN ANTONIO, TEXAS H. B. PARKS

THE ARKANSAS ACADEMY OF SCIENCE

THE twentieth annual meeting of the Arkansas Academy of Science was held at the Agricultural and Mechanical College at Monticello on April 10 and 11.

The annual public lecture was presented by Mr. Adrian Williamson, of Monticello, and the title of the address was "The Amateur Astronomer." Two field trips were arranged and conducted by the local committee—to Posey Bog and to the Mill and Chemical Plant of the Crossett Lumber Company of Crossett.

The following officers were elected for 1936–1937: *President,* L. B. Ham, University of Arkansas; *Vice-president,* P. G. Horton, Henderson State Teachers College; *Secretary,* L. M. Turner, University of Arkansas; *Treasurer,* W. R. Horsfall, Agricultural and Mechanical College, Monticello; *Editor,* Janice Singleton, Central College, Conway.

The 1937 meeting will be held at the University of Arkansas at Fayetteville.

LEWIS M. TURNER,
Secretary

THE MOBILE ACADEMY OF SCIENCE

THE Mobile Academy of Science, a local branch of the American Association for the Advancement of Science, closed its first year with the election of officers on March 5. Those elected were: *President,* Rev. Dr. P. H. Yancey, S.J., head of the department of biology in Spring Hill College; *Vice-President,* Dr. Toulmin Gaines, physician; *Secretary,* Matt J. Lawler, instructor in science, Murphy High School; *Treasurer,* Dr. A. A. English, lapidist; *Historian,* Miss Hazel Driver, head of the science department, Murphy High School; *Members of the Board of Trustees,* Dr. Stephen Hale, physician, and Dr. L. A. Loveridge, professor of physics, Spring Hill College.

During its first year the academy held bi-monthly lectures and field trips in the sciences of biology, chemistry, entomology, geology, medicine, mineralogy and physics. It also undertook the formation of a museum in the Mobile Public Library. It now has fifty active members and one honorary member, Professor A. H. Sturtevant, of the California Institute of Technology, who formerly resided in Mobile. The academy meets on the first Wednesday of every month in the Mobile Public Library.

MATT J. LAWLER,
Secretary

REPORTS

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT its meeting in April, 1936, the Committee on Grants-in-Aid of the National Research Council made the fifty-five following awards:

Physical Sciences: Robert G. Aitken, astronomer and director emeritus, Lick Observatory, "card catalog of all measures of double stars"; Willard H. Bennett, assistant professor of physics, Ohio State University, "collision of negative atomic hydrogen ions"; S. L. Boothroyd, professor of astronomy, Cornell University, "ultraviolet spectra of F. G. and M. type stars"; Paul L. Copeland, assistant professor of physics, Montana State College, "secondary emission of electrons from thin metallic films"; William W. Hansen, assistant professor of physics, Stanford University, "production of high speed electrons"; Raymond Morgan, assistant professor of physics, University of Pennsylvania, "studies in electron diffraction"; Harold Osterberg, research assistant in physics, University of Wisconsin, "elastic and piezoelectric properties of crystals"; David H. Rank, instructor in physics, Pennsylvania State College, "fine structure of certain deuterium band spectra"; Francis G. Slack, associate professor of physics, Vanderbilt University, "Verdet constant of crystals"; C. L. Utterback, professor of physics, University of Washington, "transmission of solar radiation in water."

Chemistry: Ralph A. Beebe, associate professor of chemistry, Amherst College, "measurement of heats of adsorption at low temperatures and low pressures"; William M. Blanchard, professor of chemistry, DePauw University, "conclusion of several chemical problems"; Richard Bradfield, professor of agronomy, and Wesley G. France, professor of chemistry, Ohio State University, "sedimentation equilibria and colloidal systems"; Merle Randall, professor of chemistry, University of California, "studies of heavy water"; Pierce W. Selwood, instructor in chemistry, Northwestern University, "study of magnetochemistry"; Arthur A. Vernon, instructor in physical chemistry, Rhode Island State College, "the effect of one electrolyte upon the solubility of another electrolyte in non-aqueous solvents."

Geology and Geography: Florence Bascom, senior geologist, retired, U. S. Geological Survey, and professor of geology, retired, Bryn Mawr College, "the petrology, origin and history of the Pickering and Baltimore gneisses of eastern Pennsylvania"; Kenneth E. Caster, assistant head of science department, State Normal School, Geneseo, New York, "the stratigraphy

and paleontology of the Pocono formation of Pennsylvania and adjoining areas"; Ernst Cloos, lecturer in geology, Johns Hopkins University, "the 'Martic overthrust' and the age of the Glenarm series in Pennsylvania and Maryland"; David M. Delo, instructor in geology, Lawrence College, "existing types of all North American species of the Phacopid trilobites"; Eleanora B. Knopf, U. S. Geological Survey, "internal evidence of the mechanism of plastic deformation of marble"; Waldemar Lindgren, professor emeritus of geology, Massachusetts Institute of Technology, "annotated bibliography of economic geology"; Chester R. Longwell, professor of geology, Yale University, "preparation of a tectonic map of the United States"; F. J. Pettijohn, assistant professor of geology, University of Chicago, "correlation studies in the Archean of northwestern Ontario"; V. C. Stechschulte, S.J., professor of physics, Xavier University, "study of deep-focus earthquakes"; W. T. Thom, Jr., professor of geology, Princeton University, "structural geology of the north-central Rocky Mountains and of the northwestern Great Plains region."

Medical Sciences: Peter Heinbecker, assistant professor of surgery, Washington University, "the mechanism of the altered response of smooth musculature to exogeneous epinephrine"; Albert P. Krueger, associate professor of bacteriology, University of California, "studies on the nature of bacteriophage"; C. Phillip Miller, associate professor of medicine, University of Chicago, "the immunological properties and toxicity of some chemically isolated fractions from Meningococcus"; Carl C. Speidel, professor of anatomy, Universty of Virginia, "observations on nerve and striated muscle fibers subjected to centrifuging at high speeds"; Ernest A. Spiegel, professor of experimental neurology, Temple University, "the function of the cortical labyrinth centers and their relation to the subcortex."

Biological Sciences: John B. Buck, assistant in general physiology, Johns Hopkins University, "flashing in Jamaican fireflies"; Frederick D. Chester, bacteriologist, New York Botanical Garden, "comparative study of Erwineae"; J. F. Gates Clarke, National Museum, Washington, D. C., "taxonomic study of the Oecophoridae"; John H. Davis, Jr., professor of biology, Southwestern College, Memphis, Tennessee, "ecology of Florida mangroves"; Arthur H. Graves, curator of public instruction, Brooklyn Botanic Garden, "development of a disease resistant chestnut"; Herbert C. Hanson, professor of botany, North Dakota Agricultural College, "relation of grassland type to soil type"; Frederick B. Isely, professor of biology, Trinity University, Waxahachie, Texas, "plant and soil relations in the ecology of Acridian grasshoppers"; W. Gardner Lynn, instructor in zoology, Johns Hopkins University, "field and laboratory study of the Jamaican tree frog *Eleutherodactylus nubicola* Dunn"; F. A. McClure, curator of economic botany and professor of botany, Lingnan University, Canton, China, "taxonomic investigations of bamboos"; William Seifriz, professor of botany, University of Pennsylvania, "measurement of electric potentials in plants"; M. H. Spaulding, professor of zoology, and C. J. D. Brown, instructor in zoology, Montana State College, "a biological study of the Montana grayling"; A. B. Stout, director of laboratories, New York Botanical Garden, "production and inheritance of seedlessness in grapes."

Anthropology and Psychology: Roy F. Barton, senior scientific worker, Institute of Anthropology, Ethnography and Archeology, Academy of Sciences, Leningrad, U. S. S. R., "the somatology and material and social culture of the Ifugao tribe of the Philippine Islands"; Leonard Carmichael, professor of psychology, Brown University, "the onset and development of visually controlled behavior in fetal and new-born mammals"; Paul E. Fields, professor of psychology, Maryville College, "intercorrelation of sensory discrimination abilities in the white rat"; Ernest R. Hilgard, assistant professor in psychology, Stanford University, "quantitative characteristics of the process of acquisition and extinction of conditioned responses in man"; William A. Hunt, assistant professor of psychology, Connecticut College, "behavioral response to a shot stimulus"; Theodore Karwoski, assistant professor of psychology, Dartmouth College, and Mason N. Crook, associate professor of psychology, Skidmore College, "study of the peripheral retina"; T. M. N. Lewis, professor of American archeology, University of Tennessee, "archeological investigations in Tennessee"; Dunbar Rowland, director, and Moreau B. Chambers, curator and field assistant, Mississippi State Department of Archives and History, "archeological survey of Mississippi"; William M. Shanklin, associate professor of histology and neuro-anatomy, American University of Beirut, Beirut, Syria, "anthropological study of the living Near East races"; William S. Webb, archeologist, Tennessee Valley Authority, and professor of anthropology and archeology, University of Kentucky, "archeological survey of the Tennessee River basin"; Ernest G. Wever, associate professor of psychology, and Charles W. Bray, assistant professor of psychology, Princeton University, "determination of the distortion of the ear as shown in the responses of the cochlea and auditory nerve"; Lester E. Wiley, assistant professor of psychology, Ohio Wesleyan University, "empirical testing of the theoretical learning curve derived by L. L. Thurstone."

Since the funds which have been placed at the disposal of the National Research Council during the past few years for the making of research grants have

been discontinued, there will be no further meetings of the Committee on Grants-in-Aid.

A limited fund is still available, however, for the making of grants in the medical sciences only. The next meeting of the Council's Division of Medical Sciences for the awarding of grants will be held in November, 1936. Applications should be addressed to the Secretary, Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington, D. C. Applications to be considered at the November meeting must be on file on or before October 1, 1936.

FRANK R. LILLIE,
Chairman, National Research Council

SPECIAL ARTICLES

THIOUREA AS A KEY REAGENT FOR THE PREPARATION OF ALIPHATIC SULPHONYL CHLORIDES AND BROMIDES[1]

A CLASS of organic compounds which has not received its proper share of attention by organic chemists is that comprising the aliphatic sulphonyl halides, ($R \cdot SO_2Cl$ and $R \cdot SO_2Br$) and their derivatives. They represent one of the forgotten groups in our rapid development of the chemistry of aliphatic compounds. The introduction of the sulphonic acid radical ($—SO_2OH$) into aliphatic compounds by direct treatment with sulphuric acid is extremely limited in its application and is not of practical utility. The method of synthesis which has proven most serviceable is one involving direct replacement of a halogen atom in an aliphatic compound with the sulphonic acid group by interaction with sodium sulphite. The standard procedure for conversion of sulphonic acids into their corresponding halides is by treatment with the required phosphorus halide (PCl_5 or PBr_5). In many cases, however, this method is not practical, and furthermore the use of phosphorus halides has serious objections in both industrial and laboratory operations.

Professor Karrer in the revised edition[2] of his well-known book, "Lehrbuch der Organischen Chemie," introduces the chapter on sulphonic acids as follows: "In der aliphatischen Reihe spielen Sulfonsauren eine untergeordnete Rolle (s.d.); sie sind für allgemeinere Verwendbarkeit zu schwer zuganglich."

The authors desire to report in this preliminary note that aliphatic sulphonyl chlorides and bromides can be prepared with ease without the use of phosphorus halides in any form. In place of the common phosphorus halides used in organic synthesis for preparing such halides the authors substitute thiourea. Starting with this cheap sulphur reagent and an aliphatic halide or alcohol we have developed a method of synthesis which makes the sulphonyl halides available in any quantity desired. The reaction applied, for example, for the synthesis of methyl sulphonyl chloride II is expressed below:

$$\underset{\text{I.}}{CH_3S \cdot C(=NH)NH_2} + Cl_2 + H_2O \rightarrow \underset{\text{II.}}{CH_3SO_2Cl} + \underset{\text{III.}}{ClC(=NH)NH_2} \cdot HCl$$

The s-methylisothiourea I, which is obtained in quantitative yield in the form of its sulphate by interaction of dimethyl sulphate with thiourea, reacts with nascent chlorine in cold aqueous solution to form the sulphonyl chloride II in a yield of 76 per cent. of theory. Marvel, Helfrick and Belsley[3] report that the yield of this same sulphonyl chloride II when prepared by treatment of the sodium salt of methyl sulphonic acid (CH_3SO_2ONa) with phosphorus pentachloride is 21-27 per cent. of theory. If bromine is substituted for chlorine in the authors' process an excellent yield of methyl sulphonyl bromide (CH_3SO_2Br) is obtained. A paper describing this new method of preparing aliphatic sulphonyl halides has been presented by the authors for publication in a future number of the *Journal of the American Chemical Society*.

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JAMES M. SPRAGUE

[1] From the Sterling Chemistry Laboratory of Yale University, New Haven, Connecticut.

[2] "Lehrbuch der Organischen Chemie," Vierte Auflage, Georg Thieme, Verlag, Leipzig (1936).

[3] *Jour. Amer. Chem. Soc.*, 51: 1272, 1929.

BAR DUPLICATION

IN connection with the article "Bar as a Duplication,"[1] published in the February 28 issue of SCIENCE, and signed by C. B. Bridges in Pasadena on February 21, the attention of American readers is called to the fact that essentially the same findings and interpretation as here given by Bridges had already been set forth by the undersigned in co-authorship with Prokofyeva and Kossikov in a preliminary article without figures, entitled "Unequal Crossing over in the Bar Mutant as a Result of Duplication of a Minute Chromosome Section."[2] This article was sent in on December 15, 1935, to the bi-monthly journal, *Comptes Rendus of the Academy of Sciences of the USSR*, and was published in the second number of that journal for 1936, issued on January 25. This issue probably did not

[1] C. B. Bridges, SCIENCE, 83: 210–211, 1936.

[2] H. J. Muller, A. A. Prokofyeva-Belgovskaya and K. V. Kossikov, *C.R. Acad. Sci. USSR.*, 2: 78, 1936.

reach the United States in February, but our results had been publicly announced at a meeting of geneticists in Moscow on December 26, and privately communicated to a number of American and English colleagues in December and January. We should, of course, in our original article, have called the attention of the readers to Bridges' independent or confirmatory work, had we known of it, but we must here explain that our first information concerning it was contained in the above-mentioned issue of SCIENCE. On the other hand, we did in our article mention the partially parallel work of Volotoff, of the Institute of Experimental Biology, Moscow (announced at the same meeting but as yet unpublished), in which the presence of an "inserted section," of unidentified origin, had been observed in the case of double Bar.

Our own finding came as the result of a long and deliberate search for the very structure finally found; in this we had long been hampered by certain technical difficulties. The idea that Bar may represent a duplication *in situ* had been proposed by the present author some years ago,[3] in consideration of its furnishing an explanation of the phenomenon of unequal crossing over and of certain other peculiarities of the Bar case. It may be noted that Bridges' more refined optical technique has allowed him, in this case as in others, to observe a greater degree of detail in the banding of the chromosomes than has been directly visible to us. The same principles concerning the construction of the duplication were, however, noted in both cases—the immediate juxtaposition of the two identical sections, their identical direction (not mirror-image-wise), the greater degree of transverse expansion of each section when they were duplicated than otherwise, and the greater obscurement or zigzagging tendency of their bands when duplicated. The latter two phenomena were interpreted by us both as effects of that tendency to synapsis between the anterior and posterior twin sections which, when occurring in the germ cells, results in the unequal crossing over.

We would take issue, however, with Bridges' designation of the duplication as an "inserted" piece, the point of "insertion" of which (to right or left of the original single section) is uncertain. Not only the cytological evidence, but, with much more exactitude, the fact that normals derived from Bar by unequal crossing over are never deficient, prove that the two twin sections follow immediately upon one another, without any intervening section whatever. This in turn shows that if there had been an actual insertion of a piece from one X chromosome into a sister or homologous X chromosome, one of the two points of breakage giving rise to the small fragment of the first chromosome must have been in exactly the same position as the point of breakage of the second chromosome, into which the piece from the first became inserted. Such a coincidence could be plausibly explained only on the hypothesis that a single X chromosome had become broken at the two points in question first, and then, before reattachment occurred, had doubled, forming two parallel chromatids; after that, attachments of the broken ends occurred in such a way as to result in the inclusion of both of the interstitial fragments, one after the other, into the same chromosome, while the other chromosome (if it rejoined at all) was left deficient. On this view *both* twin pieces would really have been both deleted and inserted. The simpler and more probable explanation for this case, however, is that the two sister or homologous X chromosomes were already separate at the time of breakage, that only the left-hand break occurred in one of them, and only the right-hand break in the other, and that in the subsequent process of attachment, the left-hand piece of the chromosome having the breakage further to the right became attached to the right-hand piece of the chromosome having the breakage further to the left. On this more probable view, then, the duplication did not originate as an insertion at all, and the original mutual breakage point is the point where one twin section now joins the other one. If the remaining pieces also reunited, they must have formed a complementary, deficient chromosome, which was later lost. It is evident that, on this view, the Bar duplication itself has originated by a process which may be termed "unequal crossing over." The unequal crossing over ordinarily observed in Bar is, then, only a kind of secondary unequal crossing over, resulting indirectly from the primary unequal crossing over which established the duplication in the first place.

We would also take issue with Bridges' opinion that the phenotypic effect, Bar eye, may, according to "taste," be considered either as a result of the relative dosage change of genes in the duplicated section, or as a "position effect." For evidence has been found (see discussion by the author,[3,4] chiefly based on evidence by Offermann), that Bar behaves as a neomorph. That is, the mere addition of extra doses of the general region in question (when these contain genes of normal arrangement and composition) does not increase the Bar effect; only extra doses of the Bar genetic complex itself increase the Bar effect. On the other hand, other rearrangements of genes in the Bar region, which we have no reason to suppose involve duplications, do cause phenotypic effects similar to those of the Bar duplication (the first case known to us being

[3] H. J. Muller, *Proc. 6th Int. Cong. Gen.*, 1: 213–255 (see p. 247), 1932.

[4] H. J. Muller, B. B. League and C. A. Offermann, *Anat. Rec.*, 51, 1931.

that of Stone's "Super-Bar," 1930, then Dobzhansky's "Baroid," 1931, then two "moderate-Bar" inversions of the author and many rearrangements recently reported by Volotoff). The phenotypic change is therefore solely a result of the "position effect," and this effect must be sharply distinguished from the effect of dosage change, even though in many individual cases in genetics it has not yet been possible to judge with which class of effect we are dealing.

We consider the point of chief interest in the Bar case to be its illustration of the manner of origination of extra genes in evolution. Bar had for a long time offered the best case yet known for the idea that genes could arise *de novo*. Its interpretation as some sort of duplication met with difficulties, in our ignorance of the real existence of a "position effect" of non-allelomorphic genes upon one another. Now these difficulties are resolved and there remains no reason to doubt the application of the dictum "all life from pre-existing life" and "every cell from a pre-existing cell," to the gene: "every gene from a pre-existing gene." We need at present make an exception here only of those very special conditions under which life itself, as a naked gene, originates.

That the addition of genes by duplicational processes, such as the insertion of small pieces and primary unequal crossing over, is still a factor in evolution, has previously been urged by us. We have discussed the matter recently in connection with the case of achaete and scute, in which the functional similarity found to exist between these neighboring genes suggested that a duplication had occurred in the ancestry of the normal form,[5] and we have discussed it again in the case of a small insertion (scute 19) produced by x-rays, in which a stock of individuals homozygous for the extra section is viable and fertile.[6] It was pointed out in the latter paper that the twin regions would more commonly lie near to one another, in the same chromosome, rather than far apart, as they did in this case. These papers were independent of the recent paper of Bridges[7] on "Salivary Chromosome Maps," which gives cytological evidence of the repetition of at least two sections in the normal second chromosome, and which, on the basis of these, arrives at the same general conclusions. Another case of this kind (that of the "bulb" in the normal X chromosome) has, independently of the cases of Bridges, been discovered by Offermann,[8] who again draws similar conclusions. And most recently Kossikov has found still another case, as yet unpublished. The Bar case fits in with all this convergent evidence and constitutes the first case actually observed in Drosophila of the spontaneous origination of a minute duplication capable of maintaining itself in the homozygous condition.

H. J. MULLER

[5] H. J. Muller, *Jour. Hered.*, 26: 469–478 (see p. 476), 1935.
[6] H. J. Muller, *Genetica*, xvii, 237–252 (see p. 249–250), 1935.
[7] C. B. Bridges, *Jour. Hered.*, 26: 60–64, 1935.
[8] C. O. Offermann, *Jour. Genet.*, 32: 103–116, 1936.

LIVER AS A SOURCE OF VITAMIN G

IN studies relating to the effects of diet on coccidian infections, one of the problems is that of determining the rôle of vitamins. Our previous published results[1] showed that "vitamin G" in autoclaved yeast favored the multiplication of *Eimeria miyairii* in the white rat, as indicated by oocyst counts. In a report now in press,[2] we have shown that when dried powdered liver or liver extract were employed as the sole source of vitamin G, the numbers of oocysts passed by the rats were still only a fraction of those passed by the controls, which received a basal diet plus 10 per cent. yeast. Since the growth of the rats receiving liver was considerably less than that of the reference series receiving yeast, further study on the relation of the amount of liver fed to the growth of the host and the numerical increase of the coccidium was indicated.

Nine rats having a mean weight of 76 gm were fed the basal diet made up to 10 per cent. with powdered dried liver prepared by us as a source of vitamin G and to 4 per cent. with rice polish as a source of vitamin B. Nine rats with a mean weight of 78 gm received the basal diet made up to 10 per cent. with powdered yeast (unautoclaved). During the 22 succeeding days, the test rats gained 70 gm each; the reference rats, 72 gm. It is evident that the animals receiving liver made "normal" growth. All were infected with 1,500 oocysts of *Eimeria miyairii* on the eleventh, thirteenth and fifteenth days on the diets. Subsequently, the test series eliminated a mean of 39.5 million oocysts; the reference series, 137.6 million. It is evident that the addition of liver and rice polish conditioned normal growth, but did not favor the parasite to the extent that yeast did. Furthermore, all the rats were immune to reinfection.

Nine two-week chicks were fed the growing ration we feed rats (Steenbock's), and nine the liver ration described in the preceding paragraph. After twelve days on these diets, each chicken was given 40,000 oocysts of *Eimeria tenella* from a four-month-old culture kept in a refrigerator. During the subsequent infections, the birds on the growing ration for rats eliminated a mean of 67.75 million oocysts; those on the liver diet, a mean of 4.55 million oocysts. In this case also the addition of liver to the diet as the sole source of vitamin G resulted in a much lower oocyst count. These data, however, are not so reliable as

[1] E. R. Becker and N. F. Morehouse, *Proc. Soc. Exp. Biol. and Med.*, 33: 487, 1936.
[2] *Ibid.*, in press.

those for the rats, because after sacrifice some of the caeca in both series of chicks were found plugged. The chick infections did not result in immunity.

At the present time it is not possible to say how liver acts in retarding the development of coccidian infections. The two possibilities that seem most plausible are that liver lacks the coccidium-growth-promoting substances and that liver contains a coccidicidal, or at least coccidistatic, material. Further investigation will be conducted along these suggested lines.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF HOLLOW GROUND SLIDES MADE WITH THE DENTAL ENGINE

THE method so aptly described by Dr. Marshall Hertig in a recent issue of SCIENCE[1] for making hollow ground slides with the dental engine has been in use in part by the present writer for several years in preparing slides for the mounting of diatoms, but the possibility of its more general application was not recognized. It is thought that the following supplementary suggestions and critical analysis from his own experience might add somewhat to the usefulness of the method.

Dr. Hertig mentions as part of the necessary equipment a flexible shaft or hand piece, normally part of the dental engine. This should be emphasized as essential. Slides first prepared by the writer were made with a drill press, using spherical carborundum points. Besides the greater difficulty of controlling the work, the constant angle maintained between the tool and the slide causes the carborundum point to wear unevenly, which produces an annular surface to the slide depression, visible and consequently detrimental under the lower powers of the microscope. Changing this angle while cutting the cavity produces a smooth curvature to the bottom of the depression, giving a clear and evenly lighted field, which can be done with a flexible shaft.

On first using such slides a question occurred to the writer, which may cause some misgivings in the minds of others also. Despite almost complete obliteration of the cavity when filled with balsam, due to similarity of refractive index of the balsam and the glass, there is usually enough difference in index to give some slight effect, and the question was to what extent the spurious deflection of light from a ground surface so close to the object might interfere with a critical image or produce artifacts under certain conditions.

To test possible undesirable effects various objects were examined under different powers and conditions, more significant being a critical examination of the classical test object, *Amphipleura pellucida*, under oil immersion with oblique illumination. It was thought that with a narrow beam of great obliquity, any spurious extraneous light from the ground surface of the cavity might diminish the resolution or definition of so critical an object. There proved to be no noticeable effect in any case, probably explainable by the overwhelming intensity of the controlled as compared with the diffused light, incident to any particular point on the object. It is recommended, however, that the object be fixed to the cover (as pertains in the work here described), and hence suspended over the cavity, which should be ground reasonably deep; for where the object and the bottom of the cavity fall simultaneously within the visible range of focus of the objective used the ground surface is detrimental. Also, no noticeable effects obtained in photographing objects mounted in this way, barring possible uneven lighting if the cavity was not sufficiently deep. Fortunately for this purpose the depth of focus in the higher power objectives is very shallow. With higher index media, of course, obvious and more unsatisfactory effects are produced. These tests should dispel the doubts of any who contemplate using the method according to the conditions here presented.

Some benefits may accrue from the ground surface in a possible slight whitening and brightening of the field, and in sharpness of image from diffuse rays incident to the object more close to the critical angle.

In the production of hollow ground slides with the carborundum point the writer finds very advantageous the use of a shield in the form of a block of hard wood or metal, slightly larger than a slide and about one quarter of an inch in thickness. This has on the under side a 3 by 1 inch depression into which a slide may fit. In the center of this depression there is a hole through the block one fourth to three eighths inch in diameter, countersunk from the top. This tool has the following advantages: (1) It makes it easier to hold the slide while drilling; (2) it facilitates centering the cavity on the slide; (3) it restrains the lubricant from running off the slide while drilling, and (4) it protects the slide from unsightly scratches across it if the point should slip, as well may happen, especially when first starting the cavity.

[1] Marshall Hertig, SCIENCE, 83: 2144, 110, January 31, 1936.

Though the use of such unpolished hollow ground slides may not conform entirely to the principles of theoretical microscopy, nevertheless they prove highly practicable for the most critical work.

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PREPARATION OF AVIAN SPERM SMEARS FOR MICROSCOPY[1]

EXCELLENT smear preparations of mammalian sperm (bovine, equine and human) may be made according to the method of Savage, Williams and Fowler.[2] The approximately globular heads of sperm of these species can be fixed by heat with little difficulty. The elongated heads of avian sperm, however, present technical difficulties which make dry smear preparations extremely difficult. As the smear dries the elongated heads become contorted and twisted and often assume a spiral or corkscrew shape. In other cases rupture of the surrounding membrane and complete disintegration of the head occurs. In addition to these difficulties of fixation, differential staining by means of aniline dyes is extremely difficult.

The following procedures are recommended and will be found to produce excellent results, particularly after the operator has had some experience. The first method is the more reliable and may be used for pigeon, dove or fowl sperm. The second or dry smear method can be relied on only in the case of fowl sperm.

MOUNTED PREPARATIONS

The pure semen is diluted with two to four times its volume of Ringer's solution and a drop placed on a slide that has previously been smeared with a very thin film of albumen fixative. Allow the drop to spread over an area which may be conveniently covered with a cover-slip. Drain off any excess with blotting paper. The smear is then fixed by suspending the slide in osmic acid vapor (osmium tetroxide) for thirty minutes to one hour, although longer exposures to the vapor are not injurious. A small airtight jar or chamber such as a stender dish or coplin jar may be used for a fixing chamber. A two per cent. solution of osmic acid is placed in the bottom of the chamber. Some arrangement, such as a bit of broken glass tubing in the bottom, must be made to keep the slide out of the solution. After fixation the slide is washed in several changes of water and placed in ferric alum mordant for one half hour and thence to Heidenhain's hematoxylin for one hour or more. Extract the stain from the acrosome, middle piece and tail by immersing for a few seconds in ferric alum. Considerable experience is necessary in this destaining process, since it is rather easy to under- or overdo it. The slide is now run up through the alcohols to 95 per cent. and counterstained in a one per cent. solution of light green. Light green is a very deep and rapid cytoplasmic stain and should not be confused with methyl green, which is a nuclear strain. Rinse off in 95 per cent. alcohol and run rapidly through absolute alcohol to a mixture of xylol and absolute alcohol and thence to xylol. The preparation is now mounted in balsam under a cover-slip.

It is rather difficult to secure preparations with well-stained tails. The tail absorbs the stain very poorly and loses it rapidly when rinsed and in absolute alcohol. Hence the necessity of passing quickly through these. Much of the success of the preparation depends on the completeness with which the hematoxylin has been extracted from the tails, providing, of course, that it was not also extracted from the nucleus. Because of the fact that the counterstain is readily lost, it may be found preferable to pass the slide directly into carbol-xylol from 95 per cent. alcohol and mounted directly.

Formalin vapor may be used as the fixative in place of osmic acid vapor, in which case a 15 to 20 per cent. solution of formalin (6 to 8 per cent. formaldehyde), which is somewhat stronger than that used for tissue fixation, should be employed. If osmic acid is procurable, however, it is to be preferred.

DRY SMEARS

In cases where available equipment is limited, fairly good dry-smear preparations of fowl sperm may be made by the following method.

After diluting the semen with normal saline, place one drop near one end of the slide and quickly draw out to a very thin film with a slip of paper. The film must be thin enough to dry instantaneously on the warm slide; otherwise the heads will become contorted. Fix overnight in an oven at 100° C. Stain for one-half to one hour in a freshly made preparation of carbol-fuchsin (Ziehl-Neelson's). Wash and counterstain for a few seconds to one minute (depending on microscopic control) with an aqueous solution of methylene blue, previously warmed to 40° C. If it is desired to preserve these dry smears indefinitely they may be mounted in balsam under a cover slip when dry.

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[1] Paper from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 199. Published with the approval of the Director of the Station.

[2] A. Savage, W. W. Williams and N. M. Fowler, *Trans. Roy. Soc. Can.*, 21: 425, 1927.